REPORT DOCUMENTATION PAGE

AFRL-SR-AR-TR-02-

0419

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND D/
	24 Oct 2002	Final Report 15 Sep 2002-31 Dec 2002

4. TITLE AND SUBTITLE
2002 Bird Strike Committee USA/Canada Conference

5. FUNDING NUMBERS
F49620-02-1-0374
2313/AX
61102F

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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6100 Columbus Avenue
Sandusky, OH 44870

8. PERFORMING ORGANIZATION REPORT NUMBER
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F49620-02-1-0374

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Department of the Air Force, Air Force Office of Scientific Research
801 N. Randolph St.
Arlington, VA 22203

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

Over 380 people from 20 countries and 17 exhibitors attended the 4th annual joint meeting of Bird Strike Committee-USA and Bird Strike Committee Canada in Sacramento, California on October 21-24, 2002. Attendees included 91 U.S. Air Force and 7 Air National guard personnel. In all, 51 technical papers and posters were presented, including a special session of 5 papers dealing with the use of RADAR to detect birds to reduce collisions with aircraft. The conference also had a special pyrotechnics training course for 150 of the attendees. Highlights included presentations by representatives from the Air Line Pilots Association (ALPA) and Air Transport Association (ATA) regarding the need for greater action to minimize wildlife hazards on airports, which cost civil and military aviation worldwide over $1.2 billion annually. The goal of BSC-USA is to increase communication and professionalism among the diverse groups dealing with wildlife issues on airports, and the 2002 meeting appeared to be highly successful in this regard.

14. SUBJECT TERMS

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unclassified

BIRD STRIKE COMMITTEE U *Sacramento, CA 21-24 October 2002*

COUNTRY BREAKDOWN

COUNTRY	REPS
Austria	1
Brazil	2
Canada	27
Denmark	1
Germany	2
Hungary	2
Iceland	2
Ireland	1
Italy	3
Mexico	2
Netherlands	1
New Zealand	1
Panama	2
Philippines	3
Portugal	1
Republic of China	2
South Africa	2
Sweden	1
Thailand	2
Uganda	1
United Kingdom	7
USA	316
22	382

ORGANIZATION BREAKDOWN

ORGANIZATION	REPS
AIRPORT/AVIATION INDUSTRY	69
FAA	10
MILITARY	
ARMY	1
USAF	91
USNAVY	17
MARINE CORPS	4
ANG	7
OTHER	15
PRIVATE	72
UNIVERSITY/RESEARCH	19
USDA	77
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BIRD STRIKE COMMITTEE USA/CANADA

ROSTER OF ATTENDEES

Sacramento, California
October 21-24, 2002

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ATTENDEES AT BSC-USA/CANADA 2002

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Parriott	Jack	USDA, APHIS, Wildlife Services	3419A Arden Way	Sacramento	CA	95825	USA	916-979-2675	916-979-2680	
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Pellegrino	Antonio	Italian Air Force	V. le dell 'Universite 4	Roma		00185	Italy			isv@aeronautica.difesa.it
Pennell	Christopher	AgResearch	P.O. Box 60, Gerald Street	Lincoln	Canterbury		New Zealand	643-983-3969	643-983-3913	
Pennix	Steve	U.S. Navy	B-00982, NAWS China Lake	China Lake	CA	93555	USA	760-939-3238	760-939-2980	penixsl@navair.navy.mil
Perez	Ramon	USAF, 6 OSS/OSA-BASH	7719 Hangar Loop Drive	MacDill AFB	FL	33621	USA	813-828-3981	813-828-1771	ramon.perez@macdill.af.mil
Persson	Johnny	CAA Sweden	Luftfartsverket	Stockholm-Arlanda	Sweden	S-19045	Sweden	46-8-797-6619	46-8-5936-2075	johnny.persson@lfv.se
Peurach	Suzanne	USGS, Patuxent Wildlife Research Ctr.	P.O. Box 37012, NHB, Rm. 378	Washington	DC	20013	USA	202-357-1865	202-357-1932	peurach.suzanne@nmnh.si.edu
Philiben	Scott	Precise Flight Inc.	63120 Powell Butte Road	Bend	OR	97701	USA	541-382-8681	541-388-1105	scottp@preciseflight.com
Pincek	William	San Diego International Airport	P.O. Box 120488	San Diego	CA	92112	USA	619-686-8065	619-686-8165	wpincek@portofsandiego.org
Pinos	Alistair	ICAO	999 University Street	Montreal	Quebec	H3C 5H7	Canada	514-954-8219	514-954-6759	apinos@icao.int
Pipas	Patty	USDA, APHIS, Wildlife Services	4101 LaPorte Avenue	Fort Collins	CO	80521	USA	970-266-6131	970-266-6138	
Pociecha	Michael	Port of Portland International Airport	8990 Earhart Road, #311	Oakland	CA	94621	USA	510-563-3917	510-569-3769	
Poggiali	Betsy	USDA, APHIS, Wildlife Services	6100 Columbus Avenue	Sandusky	OH	44870	USA	419-625-0242	419-625-8465	betsy.j.poggiali@aphis.usda.gov
Polillo	Albert	USDA, APHIS, Wildlife Services	Philadephia Intl Airport, Div. Of Aviation	Philadelphia	PA	19153	USA	215-937-6851	215-937-6873	albert.m.polillo@aphis.usda.gov
Price	Becky	Arkion Life Sciences	3521 Silverside Road	Wilmington	DE	19810	USA	800-468-6324	302-695-5763	
Ramage	Rex	USAF	1704 Chaput Drive	Bellevue	NE	68005	USA	402-731-9149		rex.ramage@offutt.af.mil
Rapps	Michael	Rapps Engineering & Applied Science	821 South Durkin Drive	Springfield	IL	62704	USA			
Rapsys	Vid	Geese Police, Inc.	P.O. Box 875	Naperville	IL	60566	USA	630-548-9781	630-548-9258	goosecopvid@aol.com
Rardin	Andrew	Snohomish County Airport/Paine Field	3220 100th Street SW	Everett	WA	98204	USA	425-353-2110	425-355-9883	andrew.rardin@co.snohomish.was.us
Read	Martin	USAF Reserve	19395 Edison Avenue, Bldg. 11606	Beale AFB	CA	95903	USA	530-634-1930	533-634-1864	martin.read@beale.af.mil
Reed	Julian	Rolls-Royce	P.O. Box 31	Derby	Derbyshire	DE248B5	UK	1332-244421	1332-246879	julian.reed@rolls-royce.com
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Renelt	Mark	Jet Blue Airways	2814 St. Cloud Oaks Drive	Valrico	FL	33694	USA	813-727-2009		mark.renelt@jetblue.com
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Roethlisberger	Dixie	BirdTec, Inc.	4074 155th Avenue	Hersey	MI	49639	USA	231-832-1943	231-832-0756	birdtec@yahoo.com
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Stewart	Billy	USDA, APHIS, Wildlife Services	9380 Bond Ave., Suite A	El Cajon	CA	92021	USA	619-561-3752	619-561-3862	
Stewart	Todd	USDA, APHIS, Wildlife Services	745 Arnold Avenue	Whiteman AFB	MO	65305	USA	660-687-3046	660-687-6106	todd.c.stewart@aphis.usda.gov
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Swaby	Donnavan	USAF, BASH Team	9700 Ave G, SE, Ste. 266, Bldg. 24499	Kirtland AFB	NM	87117	USA	505-846-5673	505-846-0684	donnavan.swaby@kafb.saia.af.mil
Swift	James	U.S. Navy, NAS Patuxent River	22541 Johnson Road, Bldg. 1410	Patuxent River	MD	20670	USA	301-757-0006	301-757-1889	
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Tate	Willie	USAF Reserve Command	155 Richard Ray Blvd.	Warner Robins	GA	31098	USA	478-327-0501	478-327-0308	willie.tate@afrc.af.mil
Tate-Hall	Tamela	U.S. FWS	911 NE 11th Avenue	Portland	OR	97232	USA	503-231-6164	503-231-2019	
Teague	Dennis	USAF, Eglin Air Force Base	106 Hwy. 85 North	Niceville	FL	32578	USA	850-882-4164	850-882-5321	dennis.teague@eglin.af.mil
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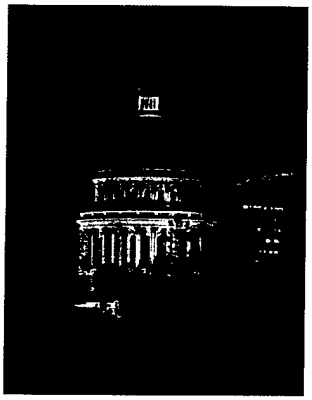
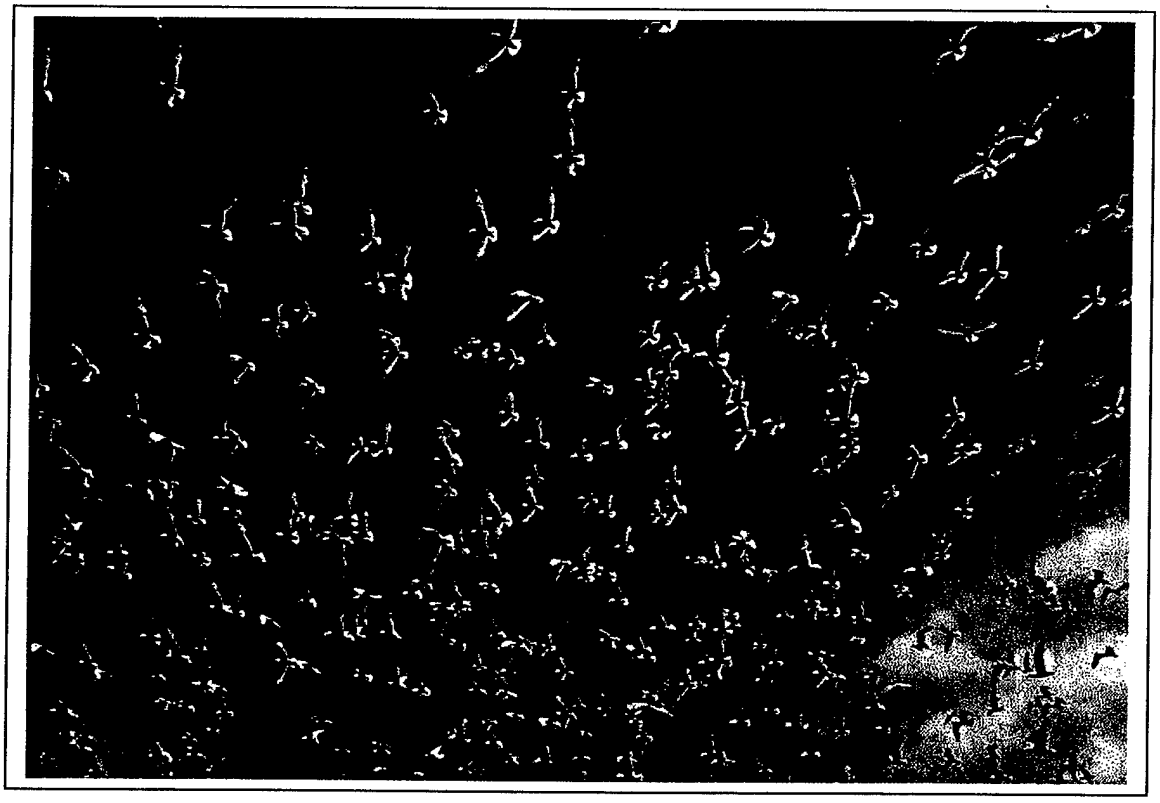


SACRAMENTO COUNTY AIRPORT SYSTEM

4th JOINT MEETING

BIRD STRIKE COMMITTEE USA/CANADA



Hyatt Regency
Sacramento, California
October 21-24, 2002

WELCOME

Bird Strike Committee-USA and Bird Strike Committee Canada welcome you to the 2002 Bird Strike Meeting in Sacramento. We have a full agenda of technical sessions, military/civil airports briefings, a field trip, demonstrations, exhibitor displays, posters, and social events that should provide ample opportunity for information exchange, networking, professional growth, and fun! Please take advantage of the various opportunities so that you can return home with fresh ideas, expanded contacts, new friends, pleasant memories, and a renewed commitment to actions that will produce safer skies for all who fly, birds and people.

Richard A. Dolbeer, Chair, BSC-USA and *Bruce MacKinnon, Chair, BSCC*

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Phone: (916) 423-1234
Fax: (916) 321-3799

Located directly across the street from the State Capital and Capital Park and within walking distance of 200 shops and restaurants, the Downtown Plaza Mall, Historic Old Sacramento, the waterfront and the California Railroad Museum.

Services

The Hyatt Regency Sacramento

- Full-service business center, offering complete computer and printing services
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REGISTRATION DESK

Located in the foyer by the Regency Ballroom

Date	*Time*
Sunday, October 20, 2002	1700-2100
Monday, October 21, 2002	0800-2000
Tuesday, October 22, 2002	0700-1800
Wednesday, October 23, 2002	0700-1200
Thursday, October 24, 2002	0700-1600

REFRESHMENT AND MEAL SERVICE

(Box lunch and coffee breaks included in registration fee)
Coffee Breaks will be located in the Exhibitor Hall in the Regency Corridor

DATE	TIME	EVENT	LOCATION
Monday, 21 Oct	1800-2000	Welcome Reception	Regency Ballroom
Tuesday, 22 Oct	1200-1320	Box lunch	Regency Foyer North
Wednesday, 23 Oct	1200-1300	Box lunch	Regency Foyer North
Wednesday, 23 Oct	1800-2000	Meet-the-Exhibitors Social	Regency Corridor

GENERAL INFORMATION

Name Badges

Please wear your name badge at all times.

Evaluation Sheets

Kindly fill out the evaluation sheet that is included in the registration packet to receive a commemorative model airplane for the Bird Strike 2002 meeting.

Technical Sessions

All technical sessions take place in the Regency DEF Ballroom
Exhibitors are located in the Regency Corridor

USA/Canada Water Volleyball Tournament

Wednesday, 23 October 2002 at 2000

Optional Tours

Guided Bird and History Walk: Wednesday, 23 October 2002, 0630-0800 in Capital Park across from Hotel. Meet in lobby at 0630.

Conference Sponsors

Bird Strike Committee USA thanks the U.S. Department of Agriculture, Wildlife Services and U.S. Air Force, Office of Scientific Research for their generous support of the conference.

EXHIBITORS (located in the Regency Corridor)

The following exhibitors welcome you to visit:

Arkion Life Sciences/FlightControl 3521 Silverside Road Wilmington, DE 19810 USA 302-695-5781 302-695-5763 fax *ballinger@flightcontrol.com*	FlightControl Plus Geese Repellent, first developed for bird strike hazards, has proven effective in conditioning geese to relocate off "no tolerance" zones such as flight operation areas, athletic fields, hospitals, etc.
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Becker Underwood 801 Dayton Avenue Ames, IA 50010 USA 515-232-5907 515-232-5961 fax *www.beckerunderwood.com*	Becker Underwood is the manufacturer of the ReJeX-iT brand product line, which is a nonlethal method of bird control. ReJeX-iT products are available in 3 formulations, sold under the brand names Fog Force, Migrate, and Crop Guardian. The active ingredient is non-toxic and can repel many species of birds.
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Clickairport Faraday House, 38 Poole Westbourne Bournemouth B4154A UK 44-1202-76531 44-1202-66536 fax *dan.leigh@clickairport.com*	Innovative wireless software applications for bird/wildlife management at airports through the use of cutting-edge technology. Rapid and accurate information received in seconds.
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Margo Supplies Ltd. P.O. Box 5400 High River, AB T1V1M5 Canada 403-652-1932 403-652-3511 fax *jmarley@margosupplies.com*	Margo Supplies provides solutions for wildlife problems. Our radio-controlled cannons and pyro launchers with rapid and simultaneous firing capabilities, deliver aggressive hazing to enhance your BASH program.
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Winfield Solutions Box 578 Frankford, ON K0K2C0 Canada 613-398-1221 613-398-8649 fax *winsol@reach.net*	As North America's leading provider of wildlife/hazard management software to airports, we are enabling staff to make cost-effective, pro-active decisions.

Bird Strike Committee USA Policy on Endorsements of Companies, Products, and Techniques

BSC-USA meetings are open to all people interested in aviation safety and in scientific-based products, techniques, and strategies to minimize wildlife hazards to aircraft. The primary goal of BSC-USA is to provide a forum (technical presentations, demonstrations, and exhibitor displays) to facilitate communication among the diverse disciplines working to minimize the conflicts between wildlife and aviation. BSC-USA thanks the various companies and individuals that share information regarding products and techniques. However, BSC-USA and the agencies represented on the BSC-USA Steering Committee do not endorse specific companies, products, and techniques that are displayed, demonstrated or discussed at BSC-USA meetings. Wildlife management is a complex endeavor, especially on airports, and products or techniques that work under one set of circumstances may not be appropriate in other situations. Attendees are encouraged to ask critical questions and to carefully evaluate information, equipment, and products presented at meetings.

Bird Strike Committee USA Steering Committee

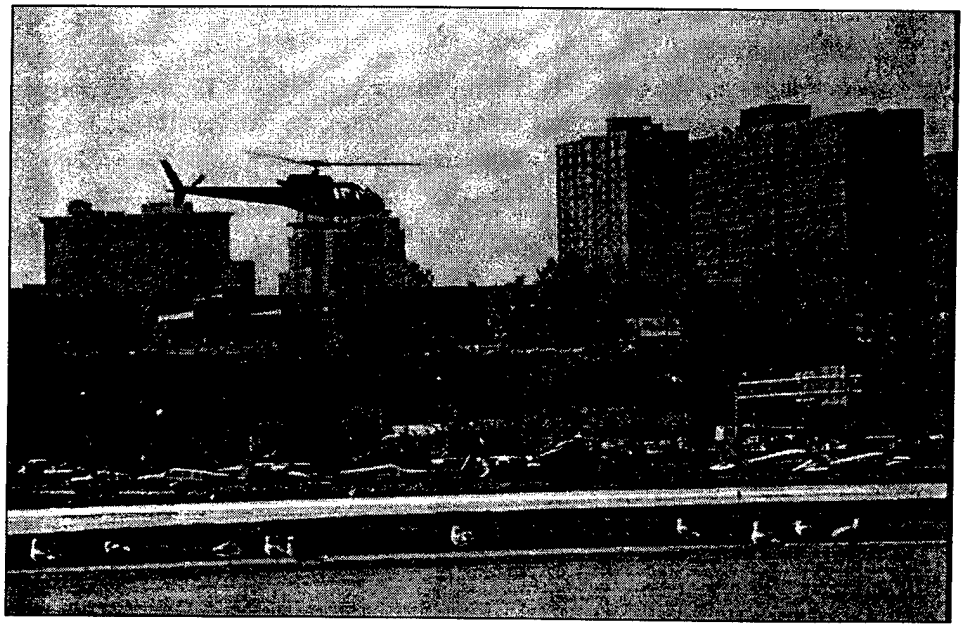
Bird Strike Committee-USA is directed by a 9-person steering committee consisting of 2 members each from the Federal Aviation Administration, U.S. Departments of Agriculture and Defense, and 3 from the aviation industry (AI). Members serve 2-year terms. Current members are:

Richard Dolbeer, USDA (Chair)
Kirk Gustad, USDA

Gene LeBoeuf, DoD
Peter Windler, DoD

Ed Cleary, FAA (Vice-Chair)
John Lott, FAA

Russ DeFusco, AI (Sec/Treas)
Paul Eschenfelder, AI
John Ostrom, AI



KEYNOTE SPEAKER

The Bird Strike Committees of USA and Canada are honored to have Dr. Walter E. "Howdy" Howard make the Keynote Address at our 2002 meeting:

Dr. Howard, who conducted his first wildlife damage control study in 1939, received his AB in Zoology from the University of California at Berkeley and his MS and PhD in Animal Ecology from the University of Michigan. He spent 3 years in World War II, starting in the ski troops in the Aleutian Islands and finishing in the USA Typhus Commission (with staff from Communicable Disease Center) on Stillwell Road in northern Burma.

He has been a teacher and researcher at University of California, Davis since 1947. Dr. Howard credits his 46 MS and PhD students and the many thousands of classroom students as also being his teacher. He became Emeritus in Wildlife Biology and Vertebrate Ecology in 1987 when he turned 70, but Emeritus is by title only for he goes to his office daily and is currently seeking a Publisher for a new book (memoirs) titled "Saved by Bedbugs".

Dr. Howard's research-lecture program has been to learn how people can best cohabitate with animals. One goal is to help people understand nature and society's moral and ethical right to use animals responsibly. His research fields include animal welfare, wildlife damage control, and how to improve the health of the environment. He has lectured extensively on these subjects and been on over 30 radio and TV programs. He has lectured or consulted in other countries 54 times since his first Fulbright Research Scholarship in New Zealand in 1957-58. He has about 500 publications and circulated reports on animal welfare and the behavior and management of wild vertebrate animals.

Dr. Walter E. "Howdy" Howard

PROGRAM

MONDAY, 21 OCTOBER 2002

0800 **REGISTRATION** (Regency Foyer)

1000 **BSC-USA STEERING COMMITTEE MEETING** (Sequoia Board Room)

1300-1700 **EARLY-BIRD PYROTECHNICS TRAINING** (Regency A and Mather Field)

1800-2000 **WELCOME RECEPTION** (Regency AB) hosted by *Sacramento County Airport System*

TUESDAY, 22 OCTOBER 2002

0700 **REGISTRATION** (Regency Foyer)

PLENARY SESSION

0800 **Welcome to Sacramento** – *G. Hardy Acree, Director of Airports, Sacramento County Airport System*

0810 **Welcome to BSC-USA/Canada** - *Richard Dolbeer, U.S. Department of Agriculture (USDA), Wildlife Services (WS), and Chairperson, BSC-USA; and Bruce MacKinnon, Transport Canada, and Chairperson BSC Canada*

0815 **Keynote Address: Managing Nature in Today's World** *by Dr. Walter "Howdy" Howard, Professor Emeritus, University of California at Davis (1)*

0845 **Plenary Address: Mandatory Strike Reporting: The Time has Come** *by Captain Paul Eschenfelder, Air Line Pilots Association (2)*

0910 **Compliance with Wildlife Hazard Regulations: An Air Carrier's Perspective** *by Vern Berry, Evergreen Intl. Airlines & Air Transport Association Safety Council (3)*

0930-1000 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION I: WILDLIFE RISK ASSESSMENT

1000 **Development of Birdstrike Risk Assessment Procedures, Their Use on Airports, and Potential Benefits to the Aviation Industry** *by John Allan, Central Science Laboratory; A. Orosz, United Airlines; A. Badham, BAA,; J. Bell, Central Science Laboratory (4)*

1020 **Improving the United States Bird Avoidance Model (USBAM) Predictive Risk Surface** *by Mark Alexander, M. Bobo, Geo InSight Intl, Inc; R. DeFusco, BASH Inc. (5)*

1040 **Implementation of GIS Technology to Detect Wildlife Hazards at Airports** *by Shelley Gray, USDA, Wildlife Services (6)*

1100 **Reported Bird Strikes at Down-State Illinois Airports** *by Michael Rapps, Rapps Engineering & Applied Science (7)*

1120 **Influence of the BASH Phase II Program on Reduction of Bird Strikes to Air Mobility Command Aircraft** *by Brian Oswalt, USAF (8)*

1140 **Development and Maintenance of Airport Wildlife Hazard Mitigation Website for the FAA and its Use as a Communication Tool** *by Archie Dickey, Allen Newman, ERAU (9)*

1200-1320 **BOX LUNCH PROVIDED** (Foyer)

TECHNICAL SESSION II: RADAR DEVELOPMENT

1320 **Progress Report on Development of a Terminal Area Bird Detection and Monitoring System Using the ASR-9** *by Seth Troxel, B. Echels, W. Pughe, M. Weber, MIT Lincoln Laboratory (10)*

1340 **A Progression of Avian Radar Studies at Airfields** *by Ed Zakrajsek, C. Matkovich, A. Smith, Geo-Marine, Inc. (11)*

1400 **Advances in Radar Technology for Bird Strike Risk Assessment** *by T. Adam Kelly, R. Merritt, R. White, M. Howera, T. West, Geo-Marine, Inc. (12)*

1420 **Bird Detection and Radar Wind Profilers** *by Scott McLaughlin, Applied Technologies, Inc. (13)*

1440 **Development of a Portable Bird Detection Radar for Airports** *by Michel Hovan, FAA Airport Technology R&D Branch (14)*

1500-1530 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION III: MANAGEMENT TECHNIQUES

1530 **Need for Certification Program for Persons Conducting Wildlife Hazard Management Activities at Airports** *by John Ostrom, MSP International Airport (15)*

1550 **Even with Good Equipment, Experienced Manpower is Necessary** *by Nigel Horton, NH Bird Management (16)*

1610 **Increasing Air Safety at Eglin Air Force Base through Vulture Roost Dispersal** *by John Humphrey, USDA, NWRC (17)*

1630 **A New Technology to Repel Birds: The High-Intensity Acoustic Bird Dispersion System (HIABDS)** *by Xi Baoshu, Zhou Mingjun, Wang Jingqun, Tsinghua University; R. Dolbeer, USDA, WS; T. Seamans, USDA, NWRC (18)*

1650 **Emergency Wildlife Management Response to Protect Evidence Associated with the Terrorist Attack on the World Trade Center, New York City** *by Rich Chipman, K. Preusser, J. Gansowski, C. Cranker III, D. Sullivan, R. Dolbeer, USDA, WS; T. Seamans, USDA, NWRC; L. Francoeur, PANYNJ (19)*

1710 **FIELD TRIP BRIEFING**

WEDNESDAY, 23 OCTOBER 2002

0630-0800 **GUIDED BIRD and HISTORY WALK** (Capital Park, meet in lobby at 0630) *led by Carl Burke, Sacramento International Airport*

0730-0845 **MILITARY/CIVIL BREAKOUT SESSION** (Regency DEF)

TECHNICAL SESSION IV: INTERNATIONAL BIRD STRIKE ISSUES

0900 **Strides in Bird Hazard Control at Entebbe International Airport** *by Gloria Bitebekezi, Civil Aviation Authority, Uganda (20)*

0920 **Bird Hazard Control Program at Panama Airports** *by Esteban Godinez, Mision de Cooperacion Tecnica de al OACI en Panama (21)*

0940 **Evaluation and Mitigation of Bird Hazards in Ex-Vaso de Texcoco: The Proposed Site of a New International Airport for Mexico City** *by Ed Cleary, FAA; R. Dolbeer, USDA, WS; P. Bastida, Universidad Nacional Autonoma de Mexico (22)*

1000-1020 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION IV (continued): INTERNATIONAL BIRD STRIKE ISSUES

1020 **The Evolution of Transport Canada's Wildlife Management and Planning Program** *by Bruce MacKinnon, Kristi Russell, Transport Canada (23)*

1040 **Wildlife Hazard Management in Micronesia: Aviation Safety in Uncharted Territory** *by Dan Vice, USDA, WS (24)*

1100 **Avian Hazard Control in Brazil: Essential Role of the Aeronautical Accidents Prevention and Investigation Center-CENIPA** *by Luiz Claudio Magalhaes Bastos, Brazilian Aeronautical Accident Prevention and Investigation Center (25)*

1120 **The Brazilian Civil Aviation Department (DAC) and Bird Strike Control in Brazil** *by Jandrisson Gurgel do Amaral, Brazilian Air Force (26)*

1140 **Bird Strikes in Courts: The Genoa Case** *by Valter Battistoni, BSC Italy (27)*

1200-1300 **BOX LUNCH PROVIDED** (Foyer)

1300-1700 **FIELD TRIP TO SACRAMENTO INTERNATIONAL AIRPORT**

Land-Use Planning to Avoid Bird Hazards around Sacramento International Airport *by John Febbo, Senior Airport Planner, Sacramento International Airport*

1800-2000 **"MEET THE EXHIBITORS" SOCIAL** (Regency Corridor)

2000 **USA *vs.* CANADA WATER VOLLEYBALL GAME**

THURSDAY, 24 OCTOBER 2002

TECHNICAL SESSION V: LARGE-BIRD ISSUES

0900 **Canada Goose Population Management at the Minneapolis-St. Paul International and Downtown St. Paul Airports** *by Jim Cooper, University of Minnesota (28)*

0920 **Monte-Carlo Simulation of Birdstrike to Support Rule Making for Large Birds** *by Julian Reed, Rolls-Royce (29)*

0940 **Aircraft Engines and Large Flocking Birds** *by Dick Parker, Pratt & Whitney (30)*

1000-1020 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION VI: HABITAT & BIRD BEHAVIOR ISSUES

1020 **Potential of Grass-Endophytes as a Bird Deterrent: Concept Testing with Canada Geese** *by Chris Pennell, P. Rolston, AgResearch Limited (31)*

1040 **Aspects of the Feeding Ecology of Avifauna at an Inland Airport, South Africa** *by Ordino and Lettie Kok, Department of Zoology and Entomology (32)*

1100 **Assessing Bird Strike Hazards in Coastal Wetlands through Field Experiments** *by John Ledbetter, City of Santa Barbara; J. Gray, URS Corporation (33)*

1120 **Effects of Location and Phase of Flight on the Behavioral Responses of Birds to Aircraft: Preliminary Observations** *by Tom Kelly, M. O'Callaghan, P. Bourke, National University of Ireland, Cork; L. Buurma, Royal Netherlands Airforce; R. Bolger, Aer Rianta (34)*

1140 **Efficacy of Aircraft Landing Lights in Stimulating Avoidance Behavior in Birds** *by Brad Blackwell, G. Bernhardt, USDA, NWRC (35)*

1200-1320 **LUNCH ON YOUR OWN**

TECHNICAL SESSION VII: HABITAT & MANAGEMENT TECHNIQUES

1320 **A Paradigm Shift in Bird Strike Prevention by the Israeli Air Force** *by Nick Carter, Border Collie Rescue, Inc. (36)*

1340 **Management of Rodent Populations at Airports** *by Gary Witmer, USDA, NWRC; J. Dewey, USDA, WS (37)*

1400 **Efficacy of Translocation of Red-tailed Hawks from Airports** *by Laurence Schafer, USDA, WS; J. Cummings, USDA, NWRC; J. Yunger, Governors State University; K. Gustad, USDA, WS (38)*

1420 **Translocating Common Nighthawks at McConnell AFB, Kansas, to Reduce Aircraft Strikes** *by John Cummings, P. Pochop, J. Davis, D. York, USDA, NWRC (39)*

1440 **A Small Pond Off-Airfield Provides More than Water** *by Nigel Horton, NH Bird Management (40)*

1500-1530 **BREAK** (Visit the Exhibitors)

TECHNICAL SESSION VIII: MANAGEMENT TECHNIQUES & WRAP UP

1530 **Automated Haze Systems with Methyl Anthranilate Eliminate Nuisance Birds in Aviation Hangars, Warehouses, Airports** *by Bruce Vergote, BirdTec (41)*

1550 **Responses of Captive Birds to Candidate Perching Deterrents on FAA LLWAS Units** *by Mike Avery, A. Genchi, USDA, NWRC (42)*

1610 **Evaluation of Electrobraid Fencing as a Deer Barrier** by *Tom Seamans, Z. Patton, K. VerCauteren, USDA, NWRC (43)*

1630-1700 **Wrap-Up and Closing Remarks** - *Bruce MacKinnon and Richard Dolbeer*

1700 **BSC-USA/CANADA Steering Committee Meeting** (All Welcome)

POSTERS (Hyatt Regency Sacramento – Regency DEF)

"Birdstrike" – What's The Word? *by Carla Dove, Smithsonian Institution (P1)*

Birdstrike Identification *by Carla Dove, Smithsonian Institution (P2)*

Attracting Arctic Foxes to Relocate a Gull Colony at Keflavik International Airport *by Pall Hersteinsson, University of Iceland; Gudmundur Örn Jonsson, Naval Air Station Keflavik (P3)*

Identification of Batstrikes *by Suzanne Peurach, USGS, PWRC and Smithsonian Institution (P4)*

Conducting an Economical Wildlife Hazard Assessment Using a Wildlife Incursion Log *by Elizabeth Rogers and David Tiller, White Water Associates, Inc. (P5)*

Status of North American Canada Goose Populations *by John Seubert, USDA, NWRC-Retired (P6)*

Environmental Analysis of Wildlife Hazard Management Programs: Application of NEPA and Possible Consequences for Implementing New Plans *by Ken Wallace, SWCA (P7)*

Successful Use of Alarm/Alert Call Playback to End Canada Goose Problems at an Ohio Business Park *by Philip Whitford, Capital University (P8)*

Animal Ambush at the Airport: The Extent and Nature of Non-bird Wildlife Strikes with Civil Aircraft, USA, 1990-2001 *by Sandra Wright, USDA, NWRC and Richard Dolbeer, USDA, WS (P9)*

ABSTRACTS

(1) Managing Nature in Today's World

Walter E. (Howdy) Howard, Professor Emeritus of Wildlife Biology and Vertebrate Ecology, Department of Wildlife, Fish and Conservation Biology, University of California, Davis, CA 95616 USA

The objective of my talk is to help airport authorities better understand the turmoil they encounter when managing birds and other wildlife populations. Many are reluctant to manage birds and mammals because they know that it will inevitably stir up controversy. Especially this is true when the program includes lethal means. Many people think all problems can be resolved by using non-lethal frightening devices or by live-trapping offending animals and relocating them away from airports. There are some sound arguments as to why it is biologically, ecologically and ethically proper to even use lethal means to resolve some airport wildlife problems. The public needs to recognize that we are dealing with people-modified environments rather than natural scenes, and that the solution to airport bird strikes, for example, cannot be left to the whims of nature. People need to understand that all animals die. Nature requires that most die before they become sexually mature and such deaths usually leaves space for another of that species. Further, when animals are killed by a wildlife manager, they nearly always die far more humanely than when they die naturally. People are the most humane of all predators. Nature, though beautiful, is a tough fang and claw arena where the survival of the fittest regime is composed of a cruel and brutal death ethic. Living in the wild is not free of suffering. The main functions of organisms are to survive, reproduce and serve as food to others. Everything in nature is linked together by eating and being eaten. The balance of nature would collapse without meat eaters and predators. Our ethic about animals is against inflicting unnecessary pain and distress to animals, but not against killing when science-based wildlife management requires it.

(2) Mandatory Strike Reporting: The Time has Come

Paul Eschenfelder, Air Line Pilots Association, 16326 Cranwood, Spring, TX 77379 USA

The reporting of wildlife collisions with aircraft in almost all places, worldwide, is voluntary. As a result data with which to design, manufacture and operate aircraft to mitigate this hazard is poor. Voluntary reporting of strikes has resulted in data collection rates in the USA of around 20%, and only about 9% of the reported strikes contain complete data on bird species. Aviation manufacturers also agree that collection of strike data is difficult, incomplete and without an industry best practice. Air carriers, when research is done, are amazed to find that strike rates may be eight times higher than their normal collection methods demonstrate. The USA safety agency, NTSB, has recommended that wildlife strike reporting be mandatory. Reporting methods and databases, in the USA and Canada, are already in place. ICAO maintains a strike database for states worldwide, but participation is poor. While the cost of mandatory reporting is often cited as a reason for not implementing mandatory reporting, the cost of not reporting is higher. Since 1995, over 130 people, worldwide, have lost their lives to collisions between wildlife and aircraft. Air carriers lose US$1.2 billion to bird strikes each year. If carriers reduced this loss by only 25%, the savings to carriers each year would be US$300 million. Without adequate data, neither the location, nor the frequency, nor the type of problem wildlife can be adequately identified. Neither adequate aircraft design nor operating techniques can be developed without data. Voluntary reporting has not worked: it is time for mandatory reporting of data.

(3) Compliance with Wildlife Hazard Regulations: An Air Carrier's Perspective

Vern Berry, Evergreen International Airlines and Air Transport Association (ATA) Safety Council, 3850 Three Mile Lane, McMinnville, OR 97128 USA

As a safety professional at Evergreen International Airlines, I have first-hand experience of the damage caused by wildlife. Seven major bird strikes have cost Evergreen approximately $20 million in damages and lost revenue over a 5-year period. These events often occurred during critical phases of flight. For example, one Evergreen B-747 suffered severe damage to engine and pylon structure with subsequent loss of control during climb. You cannot train for every possible aircraft failure induced by bird strikes. The time will come, with or without the collection of additional bird-strike statistics, when damage from a bird strike will exceed the crew's ability to recover an airplane at the limits of its performance envelope.

Most carriers sitting at the ATA Safety Council can attest to similar experiences resulting in the same flight crew excitement. However, we are not tasked with regulatory responsibility for controlling wildlife hazards on air fields. This activity belongs to the nation's airports. Our concern over the number of resident birds located on or near airports has increased to the point that we are moved to make known our concerns in a public way. We do not wish to be blindsided by a major accident when the means to reduce the risk of such accidents are available.

While the full extent of the risk is not always clear, it is clear that a bird-strike risk exists. Our costs from strike events point to it. The statistics and literature attest to increasing populations of resident and migratory birds and the increase in air traffic. Aircraft damage costs increase. Clearly, the opportunity of direct interaction between aircraft and birds has increased. It would seem that we have sufficient data to expect action. The military spends a significant amount of money in prevention efforts. Their actions to date have reduced the risks to flight crews and reduced loss of aircraft to wildlife hazards. The commercial aviation world should do no less.

Yet, I hear that we need more reporting or that the full extent of the risks is not known. Action is costly and should wait until the data point to a real problem. The ATA Safety Council finds this line of reasoning flawed. FAA Guidelines and FAR's are in place. Effective compliance with these rules and guidelines can reduce further the risks that we currently perceive. These are low hanging fruit.

Some airports are in excellent compliance---some are not. In Safety, our efforts are focused on the reduction of risk. The expectation of compliance to federal standards and guidelines is reasonable. The means to do so are available and should be enforced consistently nationwide. While new and effective means of reducing wildlife presence are developed, much can be done now if regulations are effectively enforced at all U.S. domestic airports.

(4) Development of Birdstrike Risk Assessment Procedures, Their Use on Airports, and the Potential Benefits to the Aviation Industry

J. R. Allan, Central Science Laboratory, Birdstrike Avoidance Team, Sand Hutton, York, YO41 1LZ UK
A. Orosz, United Airlines, FOD Project Manager, SFOEP – Building 84, San Francisco International Airport, San Francisco, CA 94128-3800 USA
A. Badham, BAA, Group Airport Operations Manager, 8th Floor South Roof Office Block, Gatwick Airport, West Sussex, RH6 0NP UK
J. Bell, Central Science Laboratory, Birdstrike Avoidance Team, Sand Hutton, York, YO41 1LZ UK

Over the past 2 years, CSL has been involved in the development of formal risk assessment procedures for the birdstrike hazard to aircraft. These risk assessments have now been carried out at all BAA airports in the UK, and the impact of this process on the bird management at the different airports can begin to be assessed. The risk assessment process itself has also been refined over the same period, and calculations made to determine

how the various target levels for birdstrike frequency, particularly those which, if not met, require further bird management to be undertaken, relate to absolute levels of risk (e.g., risk of financial loss or of a catastrophic accident). In parallel to this, calculations have been undertaken to determine the costs of birdstrikes to world aviation. This has involved obtaining data from particular airlines and extrapolating to the world fleet. As the airlines gather more data, the cost estimates have been refined. The impact of improvements generated by the risk assessment process can now be expressed in terms of costs saved to the industry. This paper presents the latest developments in this process, demonstrates the benefits of proper risk assessment in birdstrike prevention, and advocates the adoption of formal risk assessment in airport bird control world wide.

(5) Improving the United States Bird Avoidance Model (USBAM) Predictive Risk Surface

Mark Alexander, Geo InSight International, Inc., 7710 North Union Blvd. Suite 105, Colorado Springs, CO 80920 USA
Matt Bobo, Geo InSight International, Inc., 1015 Mark Avenue, Carpinteria, CA 93013 USA
Dr. Russell P. DeFusco, Lt Col USAF (Ret.), Vice President, BASH Inc., 5010 Lanagan Street, Colorado Springs, CO 80919 USA

The United States Bird Avoidance Model (USBAM) uses Geographic Information System (GIS) technology to analyze and correlate bird habitat, migration, and breeding characteristics, combined with key environmental and man-made geospatial features. The Application consists of raster grids covering the conterminous USA. The value for each grid pixel location is equivalent to the sum of the mean bird mass (in ounces), for all species present during a particular daily time period, for one of 26 2-week periods in a year. The original USBAM is a desktop application that has an intuitive design and includes separate interfaces for multiple user profiles such as Air Crews, and Planners/Schedulers. It is based on ESRI's ArcView GIS and can be used with other network, office, and technical applications. Geo InSight has recreated this functionality and interface in a web-based environment. The original data sets used to create the BAM (Christmas Bird Count [CBC] and Breeding Bird Survey [BBS] data from 1966-1992) have been updated to include more recent data (CBC to 1997 and BBS to 2000). An analysis of the species population records that were used for the original BAM surface with newly acquired data has been conducted. The results of these analyses and individual tests performed on a selection of priority species have resulted in an enhanced statistical methodology. These newly developed techniques have been employed on the updated datasets to improve the accuracy of the risk surface. Currently, research is being conducted to create a model to enhance the risk surfaces by linking species distributions and refined migration rules to selected co-registered environmental and topographic data layers. Based on the existing, working model, the refined migration rules for each species will be translated through a programmed logic structure. The objective of this enhanced model is to develop an improved predictive risk surface that will account for the dynamic nature of species distributions and migration patterns to and from source and destination areas.

(6) Implementation of GIS Technology to Detect Wildlife Hazards at Airports

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The use of Geographic Information Systems (GIS) for displaying spatial data is a well established technique widely used by many professions, especially natural resources. Environmental and engineering departments at many civil and military airports also use GIS to aid in planning new construction and future development. These same techniques can be applied at airports to create maps that visually portray the occurrence and location of wildlife hazardous to aircraft. At Seymour Johnson Air Force Base in North Carolina, USDA Wildlife Services uses this technology to analyze and display wildlife activity on grid maps. Wildlife observations are maintained in a database that is linked to the facility GIS. Spatial and temporal distribution of species may be selected, and this information can be overlaid on maps that depict possible wildlife attractants (e.g., rivers or ponds). Resulting maps aid in wildlife hazard management and are easily interpreted by airport operations personnel. Archived material also can be examined to detect long-term trends that may be

hazardous. The use of GIS technology to create these maps is an efficient and concise process that provides information to a wide audience concerning wildlife hazards in the fast paced airport environment.

(7) Reported Bird Strikes at Down-State Illinois Airports

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Land-use restrictions in the vicinity of airports are increasingly employed as a means to reduce bird strikes on aircraft. Yet, in the absence of controlled studies, the link between land usage and bird strikes is largely anecdotal. In seeking a connection between bird strikes and land use, the records of reported bird strikes from the years 1990-2001 were examined for 28 airports in down-state Illinois. For each airport it was noted whether land use within 6 miles of the airports included large bodies of water or wetlands, wildlife sanctuaries, golf courses, landfills, shopping venues with food concessions, or croplands. Because most bird strikes reportedly occur in the course of aircraft takeoffs and ascent or aircraft descent and landing, aircraft operations (defined as takeoffs or landings) are taken to represent opportunities for bird strikes such as might be linked to surrounding land uses. This allows the creation of a comparative statistic for the number of aircraft operations per reported bird strike. Because bird strike reports are voluntary, no attempt is made to formulate a predictive statistic. However, it is noted that the largely rural down-state Illinois airports report bird strikes (as a function of aircraft operations) far less frequently than is indicated by a comparative national statistic. The bird strike reporting frequency among the studied down-state Illinois airports is noticeably greater at the more heavily trafficked airports. It is found that land uses in the vicinity of the 28 airports that were examined do not represent an obvious linkage to bird strikes reported at those airports.

(8) Influence of the Bash Phase II Program on Reduction of Birdstrikes to Air Mobility Command Aircraft

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The purpose of the proposed study was to examine the reduction of birdstrikes to aircraft during the Bird Aircraft Strike Hazard (BASH) Phase II flight restriction periods and their affect on Air Mobility Command (AMC) and the U.S. Air Force (USAF). This study sampled the entire population of AMC airfields with BASH Phase II flight restrictions. The test period consisted of damaging birdstrike data collected 5 years before BASH Phase II operations began (1991-1995), and the years during BASH Phase II (1996-2000). It was hypothesized that since the implementation of BASH Phase II flight restrictions, there had been no significant reduction to the number of birdstrikes on AMC aircraft. During the period before BASH Phase II flight restrictions (1991-1995), AMC had a total of 35 reported damaging birdstrikes during the historic Phase II periods. Damaging birdstrikes increased in AMC to 44 from 1996-2000, when Phase II flight restrictions were imposed at these bases. The study concluded that not only was there no significant reduction in damaging birdstrikes, there was actually a 21% increase of damaging birdstrikes, AMC wide. To date, there has been no known test of the USAF BASH Phase II program to determine if it has been successful.

(9) Development and Maintenance of Airport Wildlife Hazard Mitigation Website for the FAA and its Use as a Communication Tool

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The Federal Aviation Administration's (FAA) William J. Hughes Technical Center has contracted with Embry-Riddle Aeronautical University-Prescott to develop and maintain a website dealing with a variety of issues and concerns related to wildlife and aviation. Our goal is to increase the transfer of information among biologists and the aviation community regarding the nature of wildlife hazards to aircraft and methods for reducing these hazards. The site has an on-line wildlife strike report form (FAA Form 5200-7) which also

enables users submitting strike reports to access information on wildlife management, bird identification, FAA guidelines, and strike statistics. A query system has been developed that allows authorized airport and air carrier personnel to access selected components of the FAA National Wildlife Strike Database. Other user services available at the website are current news, upcoming meetings and training, available jobs, and discussion/forum sections.

(10) Progress Report on Development of a Terminal Area Bird Detection and Monitoring System using the ASR-9

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Lincoln Laboratory has been tasked by the FAA to investigate utilization of existing terminal area surveillance radars as the basis for a real-time, automated bird hazard advisory system for the immediate airport vicinity. With its on-airport siting and rapid scan rate, the ASR-9 is a logical choice as the primary sensor for the Terminal Avian Hazard Advisory System (TAHAS). Using multi-dimensional image processing and fuzzy logic techniques, a bird-flock detection module that operates on ASR-9 data has been developed and was described at last year's conference. Refinements to the flock detection module are ongoing. Recent efforts have focused on detection of individual or small groups of birds. A measurement program was undertaken during 2 weeks in November 2001 at Austin-Bergstrom Airport, TX to ascertain the ability of the ASR-9 to detect individual or small groups of birds in the immediate airport vicinity. Simultaneous measurements provided by Geo-Marine's X-band Mobile Avian Radar System (MARS) were used to identify periods of bird and bat activity that were subsequently examined in the ASR-9 data. High-speed animations of ASR-9 reflectivity data revealed considerable numbers of individual bird-echo tracks in addition to the larger bird flock movements. Given this encouraging result, a real-time, high-update bird tracking module that extracts and displays individual bird tracks from ASR-9 data is being developed. An initial version of the tracking module has been completed and is described along with examples of its performance.

(11) A Progression of Avian Radar Studies at Airfields

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We used our Mobile Avian Radar Systems on two different projects this past year. A study at Robins Air Force Base, Georgia, used the old configuration, with a vertical-scanning radar and our image-processing technique. A study at Vancouver International Airport, B.C. used the new configuration with both vertical and surveillance radars and our new radar data processing technique. The Robins study was a preliminary assessment of seasonal bird-hazards, especially regarding the altitude distribution of birds near the airfield. Data was collected. The Vancouver study was a preliminary survey and system evaluation for the development of a real- time, dedicated Airport Bird Detection System. These two studies highlight the capabilities of avian radar systems and the improvements made over the past year. They also hint at the direction that avian radar systems are evolving as tools for managing bird hazards to aircraft.

(12) Advances in Radar Technology for Bird Strike Risk Assessment

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Since the 2001 BSC meeting in Calgary, Geo-Marine, Inc. has made dramatic advances in the development of avian radar systems. The Mobile Avian Radar System (MARS) has undergone major revisions. New radar processor cards provide the computer workstations with higher resolution data than was previously possible. The system now incorporates both horizontal- and vertical-scanning radars. The vertical scanning radar

antenna now includes a shield to reduce side-lobe interference. Significant improvements have been made in ground clutter and weather reduction algorithms. The system has been tested for use in real-time monitoring of bird hazards on airports. GMI is currently working with Transport Canada to develop a dedicated, on-airport, 3-dimensional radar for real-time bird hazard assessments. The new technology makes the real-time radar monitoring of bird hazards at civil and military airports, military ranges, and landfills possible.

(13) Bird Detection and Radar Wind Profilers

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Radar wind profilers (RWPs) are a very sensitive class of operational and research-grade meteorological radars designed specifically to detect clear air turbulence in the atmosphere. These systems have been designed with frequencies ranging from 50 MHz to 3 GHz and antenna sizes from about 1 m to >1 ha. Unlike NEXRAD systems, the antennas do not move or scan but rather are stationary and use phase-shifter arrangements to point the beam. Using the Doppler-shifted backscatter return, winds profiles can be measured from near the ground to as high as 20 km in 5- to 60-minute intervals. RWPs have been used now for over 10 years for operational weather forecasting and atmospheric research, with upwards of a hundred or so operating throughout the USA. From the beginning, it became obvious that birds flying at various altitudes could interfere with the gathering of quality wind data. In particular during bird migration events in the spring and fall, significant amounts of wind data can be lost. Algorithms have been developed to screen out contaminated data, but the contaminated data, potentially useful to ornithologists, is not currently further processed. This paper will present information about various types of clear-air radar wind profilers, how they operate, the data products they produce, current users of RWP data, and the possible use of RWP data in the bird strike community.

(14) Development of a Portable Bird Detection Radar for Airports

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The development of a prototype portable bird detection radar for airports and airfields will be presented. This prototype radar is currently being developed under a partnership between the U.S. Air Force and the FAA, and is being funded under the U.S. Air Force Dual Use Science and Technology (DUST) program. Overview of the program will be given, and detailed specifications of the radar unit, and planned tests at a commercial airport will be presented. Future Plans for an integration of this type of radar into a real-time airport bird strike advisory system will be presented as well.

(15) Need for Certification Program for Persons Conducting Wildlife Hazard Management Activities at airports

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With the complexity of tools, information and resources available to airports today, there comes a need for standardization for those persons involved in Airport Wildlife Hazard Management. One approach to standardization would be the creation of a multi-level certification program to provide the basic necessary information, training and resources to anyone involved in Airport Wildlife Hazard Management. In order to create and manage this program, the basic structure of Bird Strike Committee USA (BSC USA) would need to evolve into a more formal organization. This reorganization would create the foundation for BSC USA to provide the necessary management structure and tools to develop and maintain a certification program as well as a variety of services and resources that involve wildlife management at airports.

(16) Even with Good Equipment, Experienced Manpower is Necessary

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Maximized efficiency and quality assurance of equipment is essential to both the manufacturer and the end-user. Quite uniquely, one UK manufacturer of bird control equipment sought the views of the aerodrome bird control staff who used it. A simple tick-box questionnaire, designed by an independent biologist, was sent to each aerodrome and 37 returned completed forms, representing about half of known users in the UK. A simple subjective analysis of these produced some unexpected results that are presented here. The survey was not dissimilar to the original trials of bird distress calls on RAF airfields undertaken during the 1960's, thus allowing some direct comparison. The early playback equipment was not as robust as that currently available; the distress calls were not digitally enhanced in the 1960s; call playback fidelity should, therefore, be clearer and the response improved over the intervening 30 years. Grouping all the returns, the latest results appeared to show very much less efficiency than was found in the original RAF trials, in some species by as much as 50%. However, when the returns were analyzed by type of bird control organization on the aerodrome, the results revealed that the problem was not with the distress call or the equipment, but rested with who was using it on the aerodrome. It highlights yet again, whether the problem is gulls in the UK or rheas in South America, that equipment is ultimately only as good as the person using it. The fact that one group can use it successfully and efficiently, and reports the same to the manufacturer, is good assurance; the other groups have to rethink their strategy.

(17) Increasing Air Safety at Eglin Air Force Base through Vulture Roost Dispersal

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Forested wetlands provide attractive roost sites for black vultures (*Coragyps atratus*) and turkey vultures (*Cathartes aura*). Vultures entering and departing roosts, however, can create hazardous conditions for pilots arriving and departing nearby airports because vultures often use the same air column as aircraft. This was the case for Eglin Air Force Base and co-located Okaloosa Regional Airport in Niceville, Florida where 260 vultures roosted in nearby Turkey Creek Nature Trail. We evaluated the effectiveness of suspending a taxidermic vulture effigy in the roost, augmented by periodic use of a handheld laser management options to alleviate these aviation safety problems. The laser was used during first light and dusk on the 2nd and 3rd treatment day. Vulture numbers decreased 41% within 3 days and 100% 4 days after installation of the stimulus. Hanging a vulture effigy from a location within the roost creates an unfavorable roosting environment for vultures and offers a simple, effective means to manage problem roosts. The use of the handheld laser further decreases the desirability of the roost and quite possibly the time it takes to disperse the roost. In this study, dispersal of the vulture roost effectively resolved a potentially dangerous situation. In other cases however, dispersal of roosting birds may not decrease bird strike hazards.

(18) A New Technology to Repel Birds: The High-Intensity Acoustic Bird Dispersion System (HIABDS)

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A High-intensity Acoustic Bird Dispersion System (HIABDS), invented by Professor Xi Baoshu, is a new nonlethal device for dispersing birds from airports and other locations. The device employs a unique electro-pneumatic loudspeaker which can amplify recorded wildlife vocalizations or artificial sounds of varying frequencies to high power levels and project them over long distances. The sound pressure reaches 135 dB at 10-m distance. In China, HIABDS is being used at Lanzhou Airport to disperse upland buzzards (*Buteo hemilasius*), whose numbers declined by 80% after 1 year of deployment. During 2001-2002, HIABDS was

used at Tianjin Binhai International Airport to keep over 1,000 crows outside of runway area and at Beijing Capital International Airport during a visit by President George W. Bush. In the USA, field evaluations of HIABDS were conducted in Ohio at Burke Lakefront Airport and other sites in 2001.We recorded the response of various bird species to 6 sounds (synthetic and recorded distress calls) broadcast from the HIABDS. Turkey vultures (*Cathartes aura*) exposed to sounds from the HIABDS at 200 m dispersed from a nighttime roost, but 12 of 13 vulture groups were unaffected while soaring or perched during the day. In contrast to vultures, red-tailed hawks (*Buteo jamaicensis*) dispersed in 18 of 24 exposures to sound from the HIABDS. All 15 flocks of gulls (*Larus* spp.) within 300 m of the HIABDS dispersed whereas none of 11 flocks beyond 300 m dispersed. For Canada geese (*Branta canadensis*), 3 of 5 tests with a goose distress call caused dispersal whereas none of 8 tests with other sounds generated any reaction, even at 75 m. Mallards (*Anas platyrhynchos*) showed no reaction to any of 4 sounds in 14 of 15 tests within 300 m. European starlings (*Sturnus vulgaris*) showed a strong dispersal response to a synthetic clicking sound when broadcast within 300 m of the flock. Caspian terns (*Sterna caspia*) ignored the 4 sounds evaluated. In conclusion, sounds broadcast from the HIABDS were effective in dispersing certain species, depending on the sound used and distance of birds, whereas other species were generally unresponsive to any sounds at any distance. These findings point out the complexity of dispersing birds depending on species, behavior, and time of year. Our findings indicate that the HIABDS can be used to disperse certain birds and that such a system might be useful as part of an integrated wildlife hazard management program for airports. We recommend that a HIABDS-equipped vehicle be provided to one or more airports in North America for evaluation by the airport's wildlife control officers. This will allow for a practical evaluation of the HIABDS under field conditions and further assess the performance of the system.

(19) Emergency Wildlife Management Response to Protect Evidence Associated with the Terrorist Attack on the World Trade Center, New York City

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Human-wildlife conflicts arise under a variety of circumstances and working environments. No one could have predicted the unique working environment created by events surrounding 11 September 2001. At the request of the New York City Police Department (NYPD), the Port Authority of New York and New Jersey (PANYNJ) and the New York State Department of Environmental Conservation, a team of USDA, APHIS, Wildlife Services (WS) biologists mobilized in less than 24 hours to assist officials from the NYPD, PANYNJ and the Federal Bureau of Investigation in managing birds and rodents impacting the recovery of evidence as a result of the terrorist attacks on the World Trade Center. During the 9-month recovery effort from September 2001 to June 2002, more than 1.7 million tons of debris were shipped from "Ground Zero" in Manhattan, to a high-security crime scene at Fresh Kills landfill (FKL), Staten Island, New York. Close to a billion pieces of debris were sorted by law enforcement officials to recover personal effects, human remains and other evidence to document the crime and identify victims as part of the largest forensic investigation in the history of the USA. Within days of bringing debris to FKL (which had closed in February 2001 and was reopened after September 11), more than 2,600 gulls (*Larus* spp.) were landing and harassing law enforcement officials, making an already difficult work environment more difficult and creating a concern that evidence would be lost to birds. FKL has been a traditional feeding and loafing site for gulls and other birds (e.g., WS biologists estimated at least 100,000 gulls at FKL in November 1986), indicating a very real threat that local bird populations could increase significantly as the operation progressed. To address this unique wildlife damage management problem, WS implemented an integrated bird and rodent damage management program that eventually involved more than 66 biologists from 24 states. The goal was to reduce the impact of gulls, crows

(*Corvus* spp.), house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*) on law enforcement personnel, equipment and evidence collection. A zero-tolerance policy for gulls and crows landing on the working face was implemented to meet our objective of minimizing the risk of loss of evidence to wildlife. A combination of population surveys and direct management activities targeting gulls and crows was initiated 12-14 hours/day, 7 days/week using visual and noise deterrents including pyrotechnics, mylar tape, human and dead-bird effigies, lasers, paint-ball guns, and lethal removal of a limited number of birds. In addition, bi-weekly rodent surveys with snap traps were conducted to document population trends and explore the need for rodent control on site. We describe the evidence recovery process; the subsequent need, implementation, and efficacy of a bird and rodent management program to protect forensic evidence; and key lessons learned regarding an emergency response program to manage wildlife. Our findings are relevant to airports, waste management facilities, and other sites attempting to establish zero tolerance for birds and other wildlife that are hazardous to human health and safety.

(20) Strides in Bird Hazard Control at Entebbe International Airport

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The location of Entebbe International Airport within the Entebbe peninsula bird sanctuary would make it one of the most bird-strike prone airports in the world. However the airport actually has a relatively clean strike record. Since 1998, the number of bird strike incidents that caused damage to aircraft has been on the decline. This paper illustrates the methods used at Entebbe International Airport and their effectiveness in controlling different species of birds.

(21) Bird Hazard Control Program at Panama Airports

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ICAO Bird Information System (IBIS) has been conduced at Panama airports since 1996. Bird strike notifications, technical reports as well as wildlife control procedures have been developing as essential roles of the National Bird Hazard Committee and its Wildlife Limitation Programs. Sixty-four (64) bird strikes with different aircraft were recorded and sent to ICAO so far, while an additional 154 collisions (71%) were not reported to ICAO because of the failure to determine the aircraft involved. Among the birds struck at airports, the most outstanding species are the common barn owl (*Tyto alba*) and the black vulture (*Coragyps atratus*). One black vulture was responsible for the first air crash in Panama, on 27 January 2000, which resulted in two human fatalities. Other important large bird species are the turkey vulture (*Cathartes aura*), the crested caracara (*Polyborus plancus*) and the great egret (*Casmerodius albus*). Considering the large numbers of birds near the airports, especially during the raptor migration period, the incidence of bird impacts would be much greater, mostly during the rainy season. The wildlife control programs at the principal international airports are established through the Bird Hazard Airport Committees. Bird dispersal methods used include pyrotechnics (shot-launchers and local fireworks) and gas cannons. Removal methods include toxicants such as rodenticides and insecticides, and firearms (mostly .22 caliber rifles and pellets air rifles).

(22) Evaluation and Mitigation of Bird Hazards in Ex-Vaso de Texcoco: The Proposed Site of a New International Airport for Mexico City

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If Mexico is to meet increasing demands for air travel, a new international airport for Mexico City must be constructed. At the request of the Secretaria de Comunicaciones y Transportes (SCT), we evaluated Ex-Vaso

de Texcoco (EVT), one of several sites considered for construction of the new airport, to determine if birds would pose an unacceptable risk to aircraft. Aerial (by helicopter) and ground surveys were conducted on 6 occasions during fall and winter from 1996-2002 to census birds and evaluate aquatic habitats at EVT and other locations in the Valley of Mexico. Total populations estimates for waterfowl and shorebirds using EVT ranged from 29,000 to 77,000 (mean = 48,300). The majority of birds observed (70%) were south of the Carretera Peñon Texcoco (CPT), the highway that bisects EVT. The wetlands north of the CPT contained about 3% of the ducks and 3% of the coots in the Mexican Highland's wintering population. We concluded that an airport could be constructed in EVT north of the CPT without a significant bird-strike threat, provided habitats attractive to birds were not allowed within 3.2 km of the airport's aircraft movement areas, and conditions were not created that would encourage birds to over-fly the airport or move into or through the airport's approach/departure airspace. We recommended that wetland losses due to airport construction north of CPT should be off set by enhancing and expanding wetlands identified elsewhere in the Valley of Mexico to ensure no net loss of wetlands within the valley. Our investigation of bird issues was only one of numerous technical and economic studies conducted regarding the site selection and design of the new airport for Mexico City. Based on the conclusions of all these studies, of which birds were only one factor, an area in EVT north of CPT was selected in October 2001 as the site for the new airport. Our study demonstrated the importance of including the evaluation of bird hazards in the site-selection and design phases for any airport.

(23) The Evolution of Transport Canada's Wildlife Management and Planning Program

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As a follow-up to a paper presented at International Bird Strike Committee meeting #23 in 1996, discussing Transport Canada's emphasis on education and awareness programs as a means to reduce bird hazards to aircraft, this paper will describe significant changes that have occurred in Canada since that time. The 1994 Government of Canada National Airports Policy led to the devolution of Canada's major airports. Private sector airport authorities now operate these airports and Transport Canada's focus has shifted from management by policy to one of regulatory oversight. In addition to building on the awareness program that was in place in 1994, Transport Canada is in the final stages of introducing a performance-based regulation for Wildlife Management and Planning at applicable Canadian airports. Key components of the regulatory package are: a requirement for developing a risk assessment and management plan; an obligation to report all wildlife incidents; an obligation to provide training to wildlife control staff; and an obligation to establish a reporting and communication network. The applicability of the regulation is based on types of aircraft and number of operations, airport location and historical risk, and the presence of incompatible land-use activities.

(24) Wildlife Hazard Management in Micronesia: Aviation Safety in Uncharted Territory

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The islands of Micronesia support small, but growing, commercial and military aviation routes. A developing tourism industry, coupled with increased demands for military training sites, is bringing aviation traffic to remote and occasionally primitive island settings. While flight volumes are low relative to mainland settings, the nature of aviation in the islands is that of self- sufficiency and minimal infrastructure, which creates difficult flight situations. Pilots flying island routes face numerous challenges, including wildlife hazards that are generally unmitigated. Although major infrastructure and safety improvements have been made across many of the civilian airports in Micronesia, the impact of wildlife on aviation safety has not been thoroughly addressed; several CFR 139-certificated airfields lack basic information regarding the hazards specific to each island and most operate with no operational hazard management activities. Migratory shorebirds, resident sea birds, and resident mammals create the most severe hazards, while introduced and native forest birds present increasing hazards in some locations. This presentation will review what is known about wildlife hazards in the tropical Pacific and provide recommendations for future management actions.

(25) Avian Hazard Control in Brazil: Essential Role of the Aeronautical Accidents Prevention and Investigation Center - CENIPA

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Brazil built one of the world's largest aeronautical infrastructures. The airport net is distributed along its vast territory, which shows a tremendous ecosystem variety. Having a large civilian aircraft fleet and also running second after Venezuela in catalogued bird species, Brazil has had problems related to bird strikes. Nevertheless, Brazil is made up of 26 States plus the Federal District. Thus, besides the Union Government, each state holds its own government structure. The states are divided into counties that also have their own administrative structure. The jurisdiction of each level of government is established by the Federal Constitution, laws and others legal acts. Therefore, solutions for bird strike hazards, whose root causes are spread into all three government levels, encompass many institutions and require an orchestrated co-ordination. The paper comments on aspects of the lead role played by CENIPA, the main organization of the Brazilian flight safety system, to keep the avian hazard under control in Brazil. Among others, the following measures are considered in the paper: a) the organization and outcomes of the first national meeting about bird strike hazard control last year; b) the issue of experts report showing agreement or not, by the aeronautical authority, with the establishment of potential bird attractive activities in the vicinities of airports; c) the management and application of the national bird strike database; and d) the elaboration of an avian hazard control manual to be used by airports administrators, aircraft operators, waste facilities managers and mayors.

(26) The Brazilian Civil Aviation Department (DAC) and Bird Strike Control in Brazil

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The subject addressed in this paper is the participation of Brazilian Civil Aviation Department (DAC), and more specifically the Air Accident Investigation and Prevention Division (DIPAA) in the efforts regarding civil aircraft bird strike control in Brazil. In order to successfully achieve this intent, this paper will briefly introduce the recordings of civil aircraft bird collision registered in Brazilian Civil Aviation Department, reported by the civil aviation community (airliners, air operators, airport staff, general aviation personnel, ATC, etc.). In addition, the paper will outline the dimension of the bird strike hazard encountered by the civil fleet operating in Brazilian skies as well as in major Brazilian airfields. Finally, the paper will provide a status update of some recent civil aviation bird strike incidents in Brazil. The Contributing Factors behind the scenes of these incidents are identified, and the Safety Recommendations issued are considered.

(27) Bird Strikes in Courts: The Genoa Case

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There have not been many court cases, be it criminal or civil, concerning accidents, or even compensation for damages, following bird strikes. Generally, those involved prefer to reach an agreement out of court. The first court sentence in Italy on this subject was pronounced by the Civil Court of Genoa in 2001. The carrier had sued a number of entities (Ministry of Transport, Airport Operator, Air Traffic Control Agency) for damages resulting from a multiple impact between a BAE 146 and a flock of gulls (*Larus* sp.) that occurred on 7 June 1989 at Genoa Airport. On that occasion the aircraft managed to return to the parking stand, severely damaged with three engines out of order. This presentation describes the positions of the parties concerned and the judges' conclusions – conclusions that might obviously be modified following an appeal.

(28) Canada Goose Population Management at the Minneapolis-St. Paul International and Downtown St. Paul Airports

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A Canada goose (*Branta canadensis*) control program was initiated at the Minneapolis-St. Paul International Airport (MSP) in 1984, and at the Downtown St. Paul Airport (STP) in 1994. Flightless geese >16 km from these airports were trapped (MSP 1,734; STP 1,397), neckbanded (MSP 1,047; STP 502), and observed and counted weekly in fall at 22 and 6 locations >5 km from MSP and STP, respectively. Efficacy was also measured by observing fall goose flights through the operations airspace in 1984-1987 and 1998-2001 (MSP), and 1994-2001 (STP). Based on neckband origin of birds observed >2 km from the airfields, 3,338 flightless geese were removed from 26 MSP and 2,972 from 14 STP sites. From 1990-2001, 641 nests containing 3,604 eggs were destroyed and 458 breeding geese shot on 7 MSP wetlands. MSP populations declined significantly ($P<0.01$) from 61 (1984) to 17 geese/site (1988), and remained significantly lower in all years but 2001. MSP airspace use declined ($P<0.01$) from 25 (1984) to 4 birds/h (1986). During the 1998-2001 period, airspace counts were significantly ($P<0.05$) greater than the 1984 level in the warm falls of 1998 and 2001. December flights increased from 0 (1984-1987) to 120/h (2001). STP populations declined ($P<0.05$) between 1994 and 2001. STP airspace geese dropped significantly ($P<0.01$), from 126 to 27/h. Given a 1984-2001 projected Twin Cities breeding goose increase of 10X and an actual statewide expansion of 9X in Minnesota, the lack of growth in geese at both airports is strong evidence of program effectiveness. A negative correlation ($P<0.05$) was found between geese >2 km of MSP and airspace flights indicating that bird behavior influences flight frequency. MSP goose behavior were recorded during periods of low (1984-1987) and high (1998-2001) harassment by Airport Operations personnel. Birds flew higher and came from more directions with greater hazing, whereas hazing had no effect on the number geese in the airspace or the proportion landing on the Aircraft Operating Area.

(29) Monte-Carlo Simulation of Birdstrike to Support Rule Making for Large Birds

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A clear need was established by the aero-engine manufacturers and the certifying authorities for a re-assessment of the published rules governing engine certification for large flocking birds. A task group was set up to address this need at the beginning of 2000. Early in this program, it was determined that a statistical approach to the rule making was required and the Monte-Carlo technique was proposed and accepted. This paper discusses the implementation of the Monte-Carlo technique to simulate bird strike events from the Rolls-Royce viewpoint and describes the various refinements that have been made in order to ensure an adequate comparison with observed service data. Subsequent to this benchmarking process, the results from the analysis have been used to calculate engine shut-down rates for various proposed large bird rule scenarios ultimately leading to the acceptance of a new flocking bird certification requirement for engines of inlet area of $2.5m^2$ and above. In addition, the analysis has been used extensively within Rolls-Royce to conduct theoretical bird strike studies.

(30) Aircraft Engines and Large Flocking Birds

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This paper will present a summary of the results of the ARAC (engine) Bird Ingestion Phase II rule making effort. The effort was to evaluate the hazard to transport category aircraft, of large flocking birds, and to revise the engine certification requirements as appropriate. The paper will discuss the revision to engine certification requirements. It will also discuss the recommendation of the task group regarding the importance of continuing effort for bird control at the airport.

(31) Potential of Grass-Endophytes as a Bird Deterrent: Concept Testing with Canada Geese

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Problems caused by birds in the agricultural, horticultural, recreational and the aviation industries are escalating world wide as man develops environments that are attractive to birds. Chemical repellents, bird scarers, and exclusion netting are being used to keep birds away by taste, fright and containment. Habitat management using grasses with selected endophytes may be a new tool for minimizing bird nuisance problems in these industries. Canada geese *(Branta Canadensis)* were offered selected ryegrass/endophyte *Neotyphodium lolli* seed and herbage to examine the effects of known endophyte alkaloids on their feeding behavior in 2000-2001. Forty geese were captured annually, contained in fenced areas by wing clipping and fed entophyte-free herbage and seed for a 3-week period prior to starting any treatments. In a choice 60;cafeteria61; and no choice feeding trial, geese consumed 30% less herbage containing the selected endophyte than the endophyte-free ryegrass herbage. In a seed feeding trial, the geese did not discriminate on first exposure between the endophyte-free seed and that containing the selected endophytes. However, on day two there was an 80% rejection of the seed containing the selected ryegrass/endophyte compared to the endophyte-free seed. The same rejection of 80% was observed after a 3-month endophyte-free feeding period, suggesting the rejection was a long-term, learned response or post-digestion feedback. The authors suggest continued research into this area will be of benefit in producing a living deterrent to birds by habitat modification. Learned-behavior response has been well documented in the past as the way forward. Farming grass/endophyte associations may add to mankind's armory of bird-control methodology.

(32) Aspects of the Feeding Ecology of Avifauna at an Inland Airport, South Africa

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Bloemfontein airport, situated in the central Free State, experiences the greatest number of bird-aircraft collisions at South African airports, relative to its (low) air traffic. In an attempt to rectify the situation, aspects of the feeding ecology of birds presenting a potential hazard at the airport were investigated. Plant surveys indicated that the study area can be classified as a dry *Cymbopogon – Themeda* veld type in a relatively good condition. Using 270 pitfall traps over a continuous period of 15 months, it was established that more than twice as many ground-living invertebrates, mainly insects, occurred in grass kept permanently short (average height 22 cm) compared to those in undisturbed long grass (average height 57 cm). Based on 4,843 birds from 51 species posing a threat to aviation and which were shot as part of an ongoing management programme extending over 11 years, medium-sized, ground-living birds such as crowned plovers (*Vanellus coronatus*), blacksmith plovers (*V. armatus*), whitewinged korhaans (*Eupodotis afraoides*), doublebanded coursers (*Smutsornis africanus*), spotted dikkops (*Burhinus capensis*), cattle egrets (*Bubulcus ibis*), Swainson's francolins (*Francolinus swainsonii*) and Orange River francolins (*F. levaillantoides*) dominated the local bird population. Crop and/or stomach analyses of these birds indicate that insects, mainly Isoptera but also Coleoptera and Orthoptera, collectively constitute their main food source. The Isoptera, more specifically the harvester termite (*Hodotermes mossambicus*), is, moreover, the only important prey taxon showing a conspicuous utilization peak during the relative food shortage of the dry season. A significant and sustained decrease in harvester termite numbers and activities was accomplished by administering Gaucho-treated bait in disturbed grass areas, thereby reducing the availability of food and, hopefully, also bird numbers and bird-aircraft collisions. Implementation of a so-called long grass policy as a control strategy should have a similar effect.

(33) Assessing Bird Strike Hazards in Coastal Wetlands through Field Experiments

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Santa Barbara Municipal Airport (SBA) is located in and adjacent to Goleta Slough, a large coastal salt marsh with limited tidal circulation. Various government and non-government agencies are pursuing a long-term project to restore the historic tidal circulation to the slough to improve ecological conditions. SBA recently completed a study to assess feasibility of conducting a controlled field experiment in the slough to evaluate the relationship between bird strike hazards and the presence of tidal and non-tidal wetlands near the airfield. The study indicated that a limited field experiment, in which new estuarine marsh areas are temporarily restored, would provide valuable empirical data on bird behavior and strike hazards. The study included provisions to ensure public safety during the experiment. The information from the field experiment will be used to determine the viability of a larger, long-term wetland restoration program in Goleta Slough, and appropriate bird strike hazard management actions. The need to conduct the Feasibility Study was an outgrowth of SBA's Master Plan update process, which began in 1991. The FAA's highest priority project identified in the Master Plan is to extend the Runway Safety Areas at either of the principal runway 7-25, which will necessarily impact the surrounding Goleta Slough coastal estuary. Over the last 10 years, SBA has worked closely with federal, state, and local regulatory agencies, as well as the environmental community, to develop a restoration plan for the slough that would provide the basis for the Runway Safety Area project mitigation requirements. As the Master Plan moved through the environmental assessment phase of the approval process, it became apparent that one of the main tenants of the slough plan, the restoration of tidal circulation, could potentially exacerbate the incidence of bird strikes. As the debate began to heat-up among the environmental community, USDA/Wildlife Services, SBA, and the FAA, the approval process ground to a halt. Finally, a compromise was struck in 1998 that bifurcated the Master Plan update process and the tidal restoration project. All parties agreed that prior to any further consideration of a tidal restoration project, scientific data was needed to better understand the relationship between coastal estuarine habitat, seasonal wetlands, and the incidence of bird strikes. Thus, the Master Plan update identified a mitigation plan without tidal restoration, which ultimately included a 4:1 replacement ratio for the seasonal wetlands impacted by the Runway Safety project. On a parallel tract, all parties also agreed to move forward in a deliberate and incremental fashion towards a managed experiment to test these relationships between habitats and bird strikes.

(34) Effects of Location and Phase of Flight on the Behavioral Responses of Birds to Aircraft: Preliminary Observations

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Based on an earlier classification of avoidance movements shown by birds to moving aircraft (Kelly *et al.* 2001), we have studied the evading maneuvers of the rook (*Corvus frugilegus*) in relation to the phase of flight of air traffic at Dublin Airport, Ireland. The percentage of individuals which did not show avoidance movements was almost identical for approach/landing and take-off /climb-out movements. However, the nature of the avoiding-response in relation to the phase of flight was different. Thus 78% of responses were "Simple" in the approach/landing flight phase whereas only 5% were in this category during take-off. On omitting the approach data, the difference between take-off and landing was less marked with only 18% being "Simple" in the latter. In the case of the energetically costly "Noose"-type avoidance maneuver, 23% of rooks showed this response to aircraft on take-off as compared to 13% that were landing. Interestingly while "Protean"-type responses were relatively infrequent, they appear to occur with equal frequency during both

landing and take-off movements. Recent evidence suggests that there are marked "Protean"-type responses by woodpigeons (*Columba palumbus*) to ascending aircraft during climb-out. These findings are discussed in relation to the numbers of birds present in the different phase of flight zones on the airfield, seasonal factors, and inter-specific differences in the nature and extent of the avoidance responses.

(35) Efficacy of Aircraft Landing Lights in Stimulating Avoidance Behavior in Birds

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A potential non-lethal technique to reduce bird-aircraft collisions, aircraft-mounted light, has been considered for nearly 3 decades, but has received no formal research as to its efficacy. We tested the hypothesis that during daylight hours birds exposed to an approaching vehicle exhibiting pulsing landing lights would react more quickly than birds experiencing an on-coming vehicle with non-pulsing (steady) or no lights (control). We used the Pulselite^{Tm} system (Precise Flight, Inc., Bend, Oregon, USA), an early recognition lighting system that allows an aircraft pilot to pulse the landing, taxi, or forward-facing recognition lights, and 2 General Electric sealed-beam 250-W aircraft landing lights. Using video, we quantified avoidance behavior by captive brown-headed cowbirds (*Molothrus ater*), Canada geese (*Branta Canadensis*), European starlings (*Sturnus vulgaris*), herring gulls (*Larus argentatus*), and mourning doves (*Zenaida macroura*) in separate experiments where captive birds were exposed to a vehicle fitted with the Pulselite^{TM} system, and approaching at a consistent speed (33.5 m sec^{-1}). While most species showed no differential response to light treatments, brown-headed cowbird groups (9 groups per treatment, 6 birds per group) responded more quickly to pulse versus control treatments, equating to a greater mean [SE] distance of the approaching vehicle from mid-cage per reacting bird (control: 35.8 [9.7] m; pulse: 50.5 [10.9] m). However, in a subsequent experiment involving the exposure of brown-headed cowbirds to control, pulse, and steady-light treatments, we observed no statistical difference in response among treatment groups (6 groups per treatment; 6 birds per group). While 250-W landing lights, pulsed at 45 cycles min^{-1}, can influence avian behavior in response to an on-coming vehicle, the effects of the lights are inconsistent. We suggest that further research is needed to investigate avian response to specific ecologically relevant light wavelengths and a range of pulse frequencies.

(36) A Paradigm Shift in Bird Strike Prevention by the Israeli Air Force

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Over the past 20 years, the Israeli Air Force (IAF) has focused attention in bird strike prevention on collisions between aircraft and migrating birds during low-level flight operations. Only in the last 2 years has the IAF begun to tackle the problem of reducing bird-aircraft collisions at or near airfields. A dramatic shift in thinking has led the IAF to initiate complete wildlife control programs at its airbases, featuring the employment of border collies and wildlife control officers to help eliminate the risk of wildlife collisions within the control zone (CTR) of each airfield. As a crucial component of this program, the IAF has initiated major changes in habitat management at airfields, eliminating agricultural initiatives and undergoing large-scale modifications in airfield maintenance practices. Additionally, the IAF has altered flight and ground operations where possible to attenuate the risk imposed by birds and has coordinated efforts within various departments at each airbase to address bird strike control issues. Awareness and the resolve to eliminate wildlife hazards at its airfields are key features to the IAF's new directive on bird strike prevention. Though still in its infancy, the IAF's new wildlife control program has already shown dramatic improvements in the reduction of bird strike hazards at airbases. In light of results achieved during this short time frame, it would indicate that use of border collies can be a highly effective mechanism for the IAF to combat bird strike problems. The most important result is obviously the bottom line – there have been no damaging bird strikes to aircraft since the commencement of the wildlife control program. Moreover, the threat of a serious bird strike has been greatly reduced by the elimination of larger birds from the airfields and a 3-km radius outside the airbases, as well as the overall reduction of major bird populations on the AOA.

(37) Management of Rodent Populations at Airports

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Birds pose serious hazards at U.S. airports. Raptors are hazardous to aircraft safety due to their size, hunting behavior, and hovering/soaring habits. Abundant food sources, open space, and availability of perches at or near airports contribute to ideal hunting opportunities for many raptors. The ability to directly manage raptor populations is limited by the Migratory Bird Treaty Act. Reduction of small mammal populations at an airport may decrease raptor populations in the area and therefore, reduce the risk that raptors pose to aircraft. Rodents can be managed by population management or by habitat management. Reduction of small rodent populations can be achieved through a variety of methods, including the use of rodenticides. Zinc phosphide, a rodenticide on a grain bait, was found to be very efficacious in rodent population reduction at a USA airport, but provided only a short-term solution. We discuss the use of zinc phosphide baits in field settings, including important steps and precautions in use. We also present preliminary data on differences in rodent populations in different habitats or varying land uses at or near airports. The maintenance of low vegetation by mowing or cattle grazing resulted in lower rodent populations. Certain crops supported fewer rodents that grasslands. We will present examples of potential complications and unexpected results that have occurred when managers tried to emphasize or de-emphasize one group of species at the expense of another.

(38) Efficacy of Translocation of Red-tailed Hawks from Airports

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Raptor translocation from airport environments is a management strategy that has been recommended and used in attempts to reduce aircraft strikes. However, supportive data are lacking about optimal translocation distance and direction, return rate, post-translocation fate and overall efficacy of the technique. We conducted a study from 1 December 1999 to 28 February 2002, which included satellite telemetry, to address these issues of raptor translocation at a Midwest Airport. Two hundred and fourteen red-tailed hawks (*Buteo jamaicensis)* were translocated to 12 sites in Illinois, between 59 and 242 km from the airport. Thirty-four after-hatch-year (AHY) individuals were fitted with satellite (PTT, $n = 22$) or VHF ($n = 12$) transmitters. As of 31 October 2001, 34 (15.9%) of the 214 red-tailed hawks returned to the airport. We compared the return rate among age class, period of translocation (i.e., breeding, fall and spring migrations, and over wintering), direction of translocation, and translocation distance. Only 3.2% (3 of 93) of hatch- year (HY) individuals returned, whereas 25.6% (31 of 121) of AHY birds returned ($P < 0.001$). HY red-tailed hawks were also easiest to capture and least likely to return. No differences among the other factors were identified. The mean number of days to return was 108.6, range 2-369. Satellite data indicated that 19 of the 22 (86.3%) PTT-fitted birds dispersed from the release site within 5 days, suggesting that translocation did not result in an over-saturation of individuals at the release sites. Use of airport habitats by PTT-fitted birds was significantly different ($P = 0.009$). However, this was probably due to a single individual being relocated on airports 43 of 125 times (34.4%). Excluding this individual eliminated statistical significance ($P = 0.576$). Although PTT-fitted birds used airport habitats greater than expected, average use was extremely low, <2%.

(39) Translocating Common Nighthawks at McConnell Air Force Base, Kansas to Reduce Aircraft Strikes

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McConnell Air Force Base (MAFB) experiences a unique bird/aircraft hazard problem with migrating common nighthawks (*Chordeiles minor*) from August-October. Nighthawks are the most commonly struck species at MAFB, representing about 38% of total reported bird/aircraft strikes and 82% of the strikes from August-October. Factors that contribute to an over abundance of nighthawks on MAFB are: abundant foraging opportunities in close proximity to the airfield, available roosting habitat for nighthawks on and around the airfield, the lack of a Bird Aircraft Strike Hazard program to address nighthawks, and the location of MAFB on a nighthawk migration route. Approaches for managing nighthawks on and around airfields are limited because of their nocturnal behavior, logistics, and an incomplete understanding of nighthawk behavior. At MAFB, we determined the number of nighthawks using the airfield; their foraging, loafing and roosting areas; and their feeding habits. Based on this information, we developed a management strategy to reduce the nighthawk hazard to aircraft. From August-October in 1999 and 2000, we recorded 540 and 920 observations, respectively, of nighthawks using the airfield. The number of individuals increased rapidly during August and September, reaching a peak between 9-14 September in 1999 and 27-30 September in 2000. During one 2-hour survey period each in 1999 and 2000, 37 and 59 nighthawks, respectively, were flushed from the airfield. Most nighthawk foraging activity at the airfield occurred between 1800-2200. Nighthawks started roosting on the airfield about 1800 with a peak between 2200-0200. Thirty-seven nighthawks collected during the study period consumed a variety of insects, consisting mostly of corn earworm moths (Noctuidae—47% of stomach contents) and beetles (Scarabaeidae). Insect sweeps of the airfield indicated a low density of these species of insects, suggesting that most nighthawks foraging activity occurred away from the airfield. Management of nighthawks on MAFB has been difficult because commonly used hazing techniques seem to be ineffective. Furthermore, nighthawks have a behavior of returning to the same roosting location after being flushed which can present an even greater risk to aircraft. We developed and evaluated a unique live-capture technique for nighthawks using the airfield for the purpose of evaluating nighthawk relocation. During 1999 and 2000, 215 nighthawks were captured and relocated to sites 44 km north and 88 km south from MAFB. Only one nighthawk returned to MAFB after being relocated 44 km north. The nighthawk returned after 11 days to within 100 m of its capture location. Relocation of nighthawks from MAFB in 1999 and 2000 reduced nighthawk/aircraft strikes from 9 in 1998 when no relocation was conducted to 0 in1999 and 3 in 2000.

(40) A Small Pond Off-Airfield Provides More than Water

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Land use changes around aerodromes are becoming more problematical as conservation groups increasingly press for eco-friendly restorations, especially of water areas. Often the requirement is to encourage insects or plants or recreational use of such areas. However, these same beneficial features for biodiversity, can enhance the already considerable off-airfield bird attraction. A single case study illustrates the slow, generally unnoticed, development of a small water feature as an attraction to increasing numbers of birds and species over a period of about 10 years. This and a second study reveal how a "must feed the birds" mentality influences local bird populations. The extra food provided attracts even more birds that in turn attract more feeders; together, they increase the potential bird strike risk on the nearby aerodrome. Urbanization is increasing around aerodromes and balancing ponds for new business parks are not deep, functional holding tanks but made into ornamental water features. Here gently sloping lawns allow both staff and visitors easy access to feed the birds. By comparison, landfill sites are now relatively simple areas to control because the general public does not have access. Even when legislation exists to stop the deliberate feeding of birds, resistance groups form to oppose it and they employ direct action. This paper reviews one such site, the problems created and the law-breaking individuals with an attitude contrasting with common sense and logic. A major difficulty is that efficient airfield bird management appears to "handle" any problem from many of

these sites by ensuring that the airfield is not a safe haven for birds visiting them. As such, it is difficult to convince the developers of new water features and the bird feeders that their actions may increase the flight safety risk. A simple population model is discussed and two case studies presented.

(41) Automated Haze Systems with Methyl Anthranilate Eliminate Nuisance Birds in Aviation Hangars, Warehouses, Airports.

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Automated haze systems (The BirdHazer) combined with Methyl Anthranilate (MA) is proven effective and cost efficient as an application method for eliminating nuisance birds in aviation hangars, warehouses, and airport facilities. Proper placement of the BirdHazer system which is based on air flow circulation allows to deliver a clean, dry haze, producing a mean droplet diameter size of 5 microns , which also eliminates the possibility of permeation and any settled residue. Three preliminary test studies were successfully completed at 2 dairy barn locations, and a salt storage warehouse. The fourth testing site was conducted at a maintenance hangar at Lemoore Naval Air Station, Lamoore, CA. This hangar had approximately 50 nesting pigeons (*Columba livia*). The BirdHazer unit was installed above an office in a back corner of the hangar. Concluding results indicate elimination of all birds within the 75-ft radius. A later discovery indicated that prevailing wind direction moved the MA product to the back of the maintenance building and did not provide total coverage of the area effectively. Follow-up testing will be done in the same hangar, with a two-head haze system accompanied with vortex fans behind each haze head to break up the product particles for more effective results. The BirdHazer also shows positive results with the use of the automated timed delivery system. At the Lemoore test site, the BirdHazer will be set at 30-sec intervals every 10 min during three 1-hour periods per day. Because of the 5-micron droplet size, this timing sequence allows the invisible haze to hang in the air up to 4 hours for complete coverage throughout the hangar.

(42) Responses of Captive Birds to Candidate Perching Deterrents on FAA LLWAS Units

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Successful operation of the FAA's Low-Level Windshear Alert System (LLWAS) depends largely on birds not perching on the wind-sensing units which are installed atop poles 40-45 m tall. Because new LLWAS units will be erected at airports throughout North America, anti- perching devices must deter numerous avian species ranging widely in body size and behavioral pattern. To determine the most promising devices, we conducted pen trials with brown-headed cowbirds, fish crows, barred owls, great horned-owls and black vultures. Birds were given free access to an unmodified sensor unit mounted on a tripod for 24 hours, during which the only alternative perch was a tree branch at ground level. This was followed by 24 h with a perching deterrent installed on the sensor unit. Trials were video-taped 10 hours daily and the sensors were connected to a computer so that failures in acquisition of wind data due to perching activity were continuously recorded. Smaller birds (cowbirds, crows) tended to perch on the 3 arms of the sensor units and were mostly deterred by □Bird Spinners□, metal bushings slipped onto the sensor arms that turned freely and prevented the birds from obtaining a stable perch. Owls and vultures were not affected by "Bird Spinners", but "AgSpikes" (sharp, stout spikes emanating from a central base) reduced perching 95-98%. With the "AgSpikes" or "AgCone" (a smooth, solid aluminum cone) installed, owls and vultures attempted to perch but departed when they were not able to obtain a comfortable, stable grip. Commercial bird spikes and a monofilament web attached to the sensor arms were each ineffective regardless of species. It appears that a single perch deterrent device will not suffice for all birds, but a combination of "Bird Spinners" with "AgSpikes" or "AgCone" should be appropriate for most situations. Verification of these findings with field testing is needed.

(43) Evaluation of Electrobraid Fencing as a Deer Barrier

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Increasing white-tailed deer (*Odocoileus virginianus*) populations in North America have lead to direct threats to public safety as well as agricultural losses. Fencing is often used to keep deer from causing damage at both airports and agricultural areas. Tall, chain-link fences have been used successfully but are often prohibitively expensive. Electric fences have potential to offer a less expensive alternative. We tested a new electric fence design marketed under the name ElectroBraid. This fence, comprised of 0.6-cm polyester rope with copper wire woven into it, is carried on frangible, fiberglass posts set at 15-m intervals. From January to March 2002 we conducted both 1- and 2-choice tests on free-ranging deer in northern Ohio. We measured deer intrusions and corn consumption at 10 pairs of fenced sites with and without electricity. Mean deer intrusions at treated sites in both 1- and 2-choice tests were < 1/day while control site intrusions were 84-86/day. Mean corn consumption by all wildlife (e.g., deer, raccoons [*Procyon lotor*], fox squirrels [*Sciurus niger*]) differed between treated (< 2 kg/day) and control sites (15 kg/day). Based upon the results of this test and the cost of ElectroBraid we conclude that this fence, under the conditions of this 5-week test, was an effective and economical deer barrier.

POSTERS (Hyatt Regency Sacramento – Regency DEF)

(P1) "Birdstrike" – What's the Word?

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The word(s) "bird strike", "bird-strike", or "birdstrike" has been used inconsistently throughout the literature for as long as birds have been colliding with aircraft. A recent search of peer-reviewed articles in the Zoological Record and Biological Abstracts dating back to 1969 resulted in 52 articles that pertained to bird-aircraft collisions. Of those, 67% used two words (bird strike); 22% used a hyphenated word (bird-strike); 5.5% used one word (birdstrike), and 5.5% actually used both two words and the hyphenated version in the same paper! A brief glance through the proceedings and abstracts of recent *Bird Strike Committee Meetings* also exemplifies the inconsistent use of the word(s) that we apply to our profession.

The *Oxford English Dictionary* (1989) lists bird-strike as a hyphenated word under section (9) Special comb[inations]... of the word bird. However, they go on to cite references of the first published versions of this word in newspaper articles which quoted it as one word 'birdstrike' (*Daily Telegraph*, 19 June 1963; *Idle Moments*, 15 Oct. 1967). For this discrepancy, we turned to the scientific literature. According to the rules of scientific nomenclature (*The International Code of Zoological Nomenclature [1964]* Article 23 - Law of Priority)..."The valid name of a taxon is the oldest available name applied to it...[published]" Although this rule was established to settle differences in the proper naming of species and not inventing words for the English language, it is referenced here because interviews with a linguist (Dr. Suzanne Kemmer, Rice University, personnel communication) revealed that there are no English rules for creating compound words. However, the normal evolution of a new word is generally from two words - to a hyphenated word - to one word, depending on the frequency of use. Therefore, even if we dismiss the scientific rules of "*The Code*", the term for bird-aircraft collisions has been in use since at least the early 1960s. This year marks the 12th annual meeting of *Bird Strike Committee USA*. It is time that we begin consistent use of **BIRDSTRIKE** as one word in published articles and recommend a change in the Air Force Pamphlet 91-212 (1 April 1997 – Safety) to reflect the modern day, modern-day, or modernday use of the word.

(P2) Birdstrike Identification

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Identification of feather evidence retrieved from birdstrikes provides essential information that allows airfield managers, engineers, pilots and government agencies to work together to prevent damaging birdstrikes. Knowing the identity of the birds that are causing problems is the first step in formulating a plan to discourage birds from interfering with aviation safety. The feather identification process is complex and involves cleaning feather material, microscopic examination, and whole feather comparisons with specimens in a museum collection. This poster presents the feather identification technique and provides information to various agencies on how and where to send birdstrike remains for identification.

(P3) Attracting Arctic Foxes to Relocate a Gull Colony at Keflavik International Airport

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The Lesser Black-backed Gull (*Larus fuscus*) colony at Keflavik International Airport has grown from around 1,000 pairs in 1975 to over 20,000 pairs in the early 1990s and to around 30,000 pairs in 2000. The colony is considered a serious hazard to both military and civil air traffic. The population of arctic foxes (*Alopex lagopus*), the only predator in Iceland capable of preying on these gulls, was very small in this area from the late 1950s until the mid-1980s. A decade ago we noted that the location of the colony had shifted away from an arctic fox breeding den near the airport. As there were no natural arctic fox breeding dens at the location of the gull colony and as the geography was not suitable for such dens, we constructed an artificial den there in autumn 2000 to attract arctic foxes to breed there. The design of the den was based on that of a natural arctic fox den excavated elsewhere. Between January and April 2001, bird carcasses were placed at the artificial den on a regular basis to attract the foxes' attention to the den. Tracks in snow showed that foxes visited the den and removed the gull carcasses. Two vixens, one pregnant and the other lactating, were killed in the vicinity of the den in May and June 2001, respectively, and it was not used as a breeding den that year. We propose that arctic foxes should be totally protected in the area in order to test (a) whether wild arctic foxes are prepared to use an artificial den for rearing their pups, and (b) whether the occupation of a strategically placed den will result in a relocation of the gull colony to an area where aviation hazards are not a problem.

(P4) Identification of Batstrikes

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Identification of fragmentary evidence such as hairs, bones, and claws that have been recovered from United States Air Force (USAF) aircraft has been undertaken by the Biological Survey Unit (USGS) for the last 5 years. The results of these investigations may be useful in preventing future damaging batstrikes. Examination of batstrikes may also provide valuable information to the scientific research community about patterns in bat migration, flight altitudes, and times of flight. Positive identifications are made by comparing unknown samples with the collection of museum specimens housed in the Smithsonian Institution's National Museum of Natural History. Macroscopic characters such as color, texture, and size help narrow the possibilities, while microscopic features such as patterns seen in scales and medulla of the hair can be used to distinguish major groups of bats. All but eight of the 70 reported wildlife strikes during this reporting period were identified to species level. The Brazilian free-tailed bat (*Tadarida brasiliensis)* was struck 23 times, while the red bat (*Lasiurus borealis)*, was identified from 15 strikes. The hoary bat (*Lasiurus cinereus)* was only identified in 10 strikes although this large species of bat caused the most damage to USAF aircraft. Damage reported from these strikes by the USAF totaled over $50,000. One strike alone caused over $21,000

in damage. An examination of damage caused by different species indicates that Brazilian free-tailed bats caused approximately $12,000 while the second most commonly hit bat, the red bat, caused no damage, even though several strike reports documented multiple impacts with these bats. These results indicate that body mass plays a large role in damages incurred by collisions with these bats.

(P5) Conducting an Economical Wildlife Hazard Assessment Using a Wildlife Incursion Log

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Small and moderate-sized airports face increasing financial constraints. A need for a wildlife hazard assessment can represent a real financial hardship. We describe how a wildlife incursion log maintained by airport personnel can provide an economical means of assessing wildlife hazards in a rural landscape. Using such a log with records for 208 days, we created a relational database that could be analyzed with simple summary statistics. Using the incursion log, we examined seasonal shifts in average daily incursions (such as increased sandhill cranes in the spring), persistent year- round presence of some species (such as American crow), and the influence of time of day on the percentage of incursions by species (most incursions occurred in the morning hours). Flock size was also frequently recorded, allowing us to assess average flock size by month and frequency of flock sizes for various species. Some modest improvements and training of personnel in identification and record keeping would further enhance the usefulness of this type of data collection. We conclude that assisting small airports with the set up of a wildlife incursion log can be useful for both hazard assessments as well as ongoing monitoring needed in an adaptive management protocol.

(P6) Status of North American Canada Goose Populations

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North American Canada goose (*Branta canadensis*) populations continue to increase, causing potentially greater hazard to aviation. There is greater interest by biologist and aviation interests in monitoring the status of these populations because of the increasing number of Canada goose strikes to aircraft. Waterfowl in North America are managed in four administrative flyways – the Atlantic, Mississippi, Central, and Pacific. Goose numbers in these flyways are based on mid-winter or breeding period counts. The Canada goose count for North America in 2000 was 5,728,000—61% were the large resident geese. The resident component of the population has increased more than 3-fold from 1990-2000. Reported Canada goose strikes on aircraft have increased during recent years. For the years 1990-2001, Canada geese were identified in 61% of all goose strikes (606 of 985) reported to the FAA. Also, during the same reporting period, geese caused engine damage in 139 of the 985 strikes. Canada geese damaged 61% of the engines (85 of 139). The numbers of operating commercial jet aircraft and scheduled departures by airlines increase yearly. The higher number of Canada goose strikes probably is due to a greater awareness of the hazard and better reporting of strikes, and to the exposure of more commercial aircraft to increasing Canada goose populations. Aggressive integrated Canada goose management programs should continue or be undertaken to reduce this hazard.

(P7) Environmental Analysis of Wildlife Hazard Management Programs: Application of NEPA and Possible Consequences for Implementing New Plans

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The operating certificate required for airports that accommodate commercial-service air carriers stipulates that the airports be able to conduct safe operations, pursuant to the Federal Aviation Act of 1958. Under Federal Aviation Regulation Part 139, most airports must prepare and implement a wildlife hazard management plan (WHMP) as part of the certification process. Required components of the WHMP include the *priorities for needed habitat modification and changes in land use* as a result of those modifications. Because habitat modification is often a relatively permanent procedure to reduce wildlife use of airports, it is a preferred method by airport operators for hazard abatement. There are likely to be federal and state permits associated

with habitat modifications, such as those needed for wildlife removal, discharges to surface water, or dredging and filling activities in wetlands. However, proposed activities to reduce or eliminate habitat at Part 139-certified airports are also subject to review under the National Environmental Policy Act (NEPA). Virtually all activities involving federal funding or approval at these airports require some level of analysis for compliance with NEPA; most of these activities are either specifically categorically excluded from a formal environmental assessment, or need at most an environmental assessment to document the lack of significant environmental impacts. In contrast, modifications to most "natural" wildlife habitats, even those undertaken to increase aviation safety, are not categorically excluded from environmental assessment. It is reasonable to assume that habitat modifications would in most instances require preparation of an environmental impact statement, either because of the potential to result in significant effects on the environment or the highly controversial nature of the activity. The reasoned, procedural nature of NEPA and the often-lengthy EIS process may appear to conflict with the urgency associated with wildlife hazard reduction at airports. A case study in southeast Alaska is used to illustrate the influence of NEPA on wildlife hazard management, in particular habitat modification actions.

(P8) Successful use of Alarm/Alert Call Playback to End Canada Goose Problems at an Ohio Business Park

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Burgeoning continental resident Canada goose populations have led to increases in aircraft strikes. Once on or near airfields, geese have proven difficult to move and keep away. Playback of naturally recorded alarm and alert calls of the species was coupled with multiple harassment techniques to determine if this strategy would prove effective at removal of long-term resident geese from a 24-ha business park in Dayton, Ohio. The study began 26 February 2002, following territorial establishment by the geese, and continued until the last few geese had abandoned the property as of 14 May 2002. Most geese present were reusing nest territories from previous years, and thus strong nest-site fidelity made these perhaps the most difficult of all geese to remove in a nonlethal manner. Call playback used three "Goosebuster" units (Bird-X Corp. Inc., Chicago IL). Daily direct human harassment consisted of chasing geese on foot and placing objects such as owl decoys, sticks, or balloons in nests. Other harassment included sporadic use of two Chesapeake retrievers over 7 mornings, but this harassment was not considered essential to discourage return by geese. Reports of goose aggression toward and injury to employees fell from 32 and 2 cases, respectively, in 2001 to zero in 2002. Employee time spent in harassment fell from 3-4 hours/day at the start to under 15 minutes/day. Goose droppings/100 m of walks fell from a mean of 195.7 to 3.3 between 26 February and 24 March 2002, a 98% reduction ($P < 0.01$), and remained low thereafter. Twice daily cleaning of walks done prior to the study was deemed unnecessary by week 2 of the study, more than offsetting employee time in harassment activities. Continued alarm-call playback at random 10- to 20-minute settings appeared to help prevent return of resident geese or recolonization of the property by other geese. Goose use of the property dropped from 1600-1800 goose-hours/day before testing to fewer than 150 goose-hours/day by week 3 and to zero hours by May. Similar techniques may prove useful as nonlethal means to remove geese from areas on or near airports where they constitute a threat to air traffic.

(P9) Animal Ambush at the Airport: The Extent and Nature of Non-bird Wildlife Strikes with Civil Aircraft, USA, 1990-2001

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Richard A. Dolbeer, USDA, Wildlife Services, 6100 Columbus Ave., Sandusky, OH 44870 USA

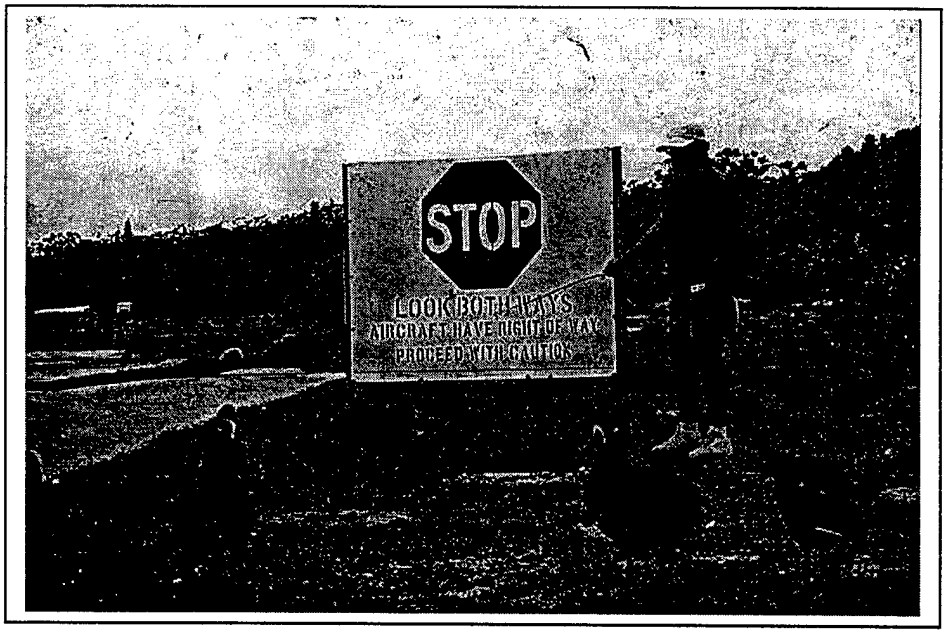
Birds have long been recognized as a serious threat to aviation safety. However, other wildlife (mammals and reptiles) can also have a serious impact on aircraft. From 1990-2001, 1,029 strikes to civil aircraft involving wildlife other than birds were reported to the Federal Aviation Administration (FAA). Deer (522) and coyotes (115) were the most commonly struck wildlife. Other non-bird species struck included rabbits, woodchucks, turtles, alligators, and iguanas. Whereas 14% of bird strikes resulted in aircraft damage and 9% had a negative

effect on the flight, 47% of strikes with other wildlife caused damage and 33% had a negative effect on the flight. Although non-bird wildlife strikes represented less than 3% of the reported strikes in the FAA national database from 1990-2001, 13 (54%) of the 24civil aircraft that were destroyed due to wildlife strikes were caused by these non-bird species. We conclude that 1) Birds are not the only wildlife hazard to aviation. Runway incursions by various mammals and reptiles can result in major damage to aircraft and loss of life and must be taken seriously; 2) In the USA, these wildlife strikes should be reported to the FAA in the same manner as bird strikes. The International Civil Aviation Organization (ICAO) presently collects data on bird and bat strikes. ICAO should include other wildlife strikes in its database; and 3) We propose that the size limit for reporting non-bird strikes, other than bats, be animals greater than 200g (the size of a Norway rat [*Rattus rattus*] or about ½ pound). All bat strikes should be reported.

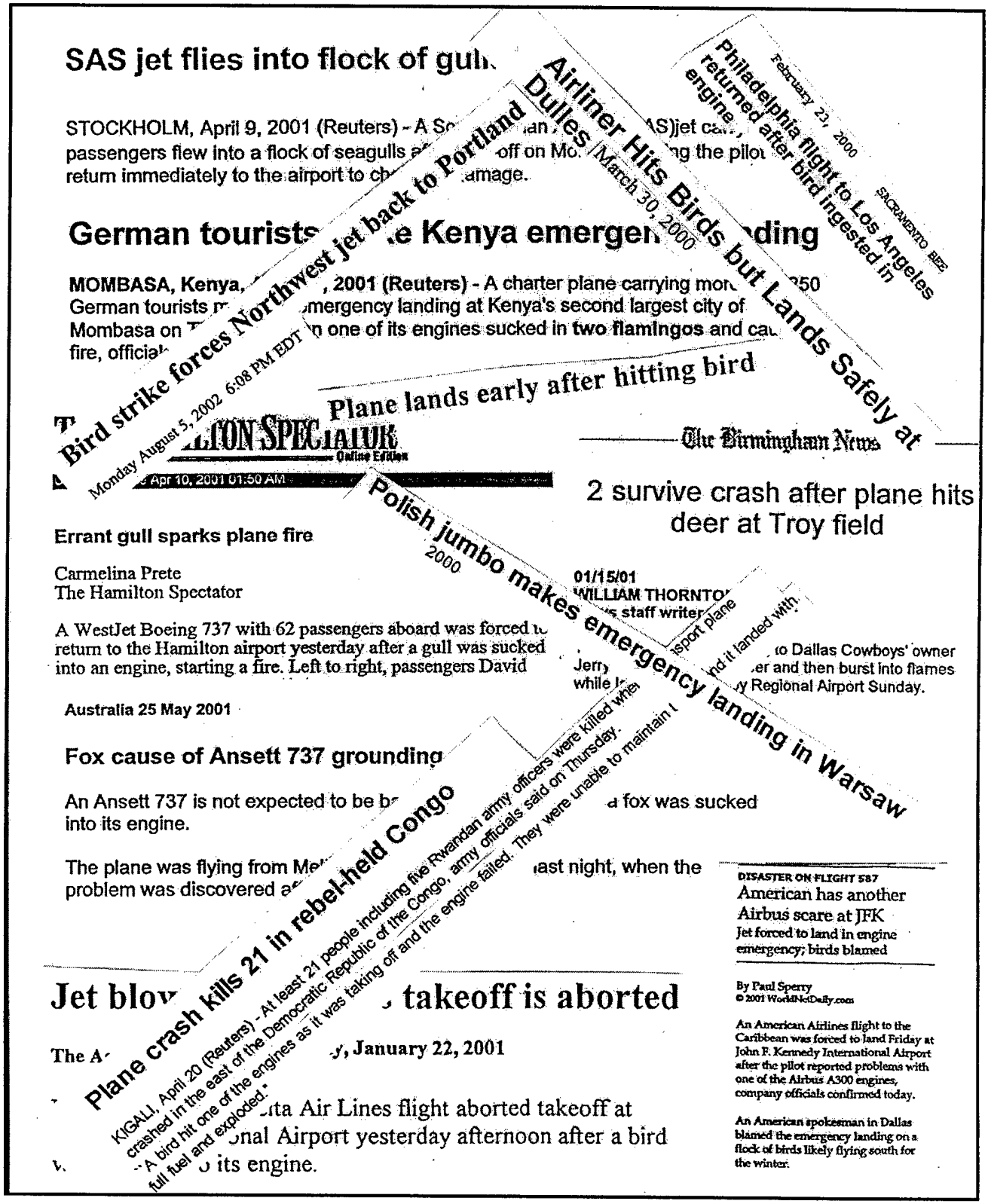
NOTES

DID YOU KNOW THAT?

- Over 400 people have been killed and 400 aircraft destroyed worldwide as a result of wildlife strikes.
- Wildlife strikes cost USA civil aviation over $400 million/year, 1990-2001.
- About 5,700 bird strikes were reported for USA civil aircraft in 2001. The U.S. Air Force recorded over 3,700 bird strikes in 2001.
- Over 2,700 bird strikes at heights >3,000 feet above ground level were reported for USA civil aircraft, 1990-2001; 113 of these strikes resulted in substantial damage to the aircraft.
- An estimated 80% of bird strikes to USA civil aircraft go unreported.
- Waterfowl (31%), gulls (29%), and raptors (17%) comprised 77% of the birdstrikes to civil aircraft in which damage was reported, USA, 1990-2001.
- Over 500 civil aircraft collisions with deer were reported in the USA, 1990-2001.
- A 12-lb (5.5 kg) Canada goose struck by an aircraft at 150-mph generates the force of a 1,000-lb weight dropped from a height of 10 feet.
- Starlings (3 oz, 80 g) are "feathered bullets", having a body density 27% higher than herring gulls.
- From 1990-2001, 607 unidentified hawks, 552 American kestrels, 332 red-tailed hawks, 51 eagles (bald and golden), and 35 peregrine falcons were reported as struck by civil aircraft, USA.
- Thirteen of the 14 bird species in North America with body masses greater than 8 lbs (3.6 kg) have shown significant population increases, 1970-2000. The North American non-migratory Canada goose population more than tripled from about 1 million to 3.5 million birds, 1990-2000.



Wildlife Strikes in the News



SAS jet flies into flock of gul

STOCKHOLM, April 9, 2001 (Reuters) - A S an AS)jet c passengers flew into a flock of seagulls a off on Mo g the pilo return immediately to the airport to ch amage.

German tourists e Kenya emergen ding

MOMBASA, Kenya, , 2001 (Reuters) - A charter plane carrying mor 250 German tourists m mergency landing at Kenya's second largest city of Mombasa on n one of its engines sucked in two flamingos and cau fire, official

Bird strike forces Northwest jet back to Portland

Monday August 5, 2002 6:08 PM EDT

Airliner Hits Birds but Lands Safely at Dulles

March 30, 2000

Philadelphia flight to Los Angeles returned after bird ingested in engine

February 23, 2000

SACRAMENTO BEE

Plane lands early after hitting bird

THE HAMILTON SPECTATOR Online Edition

Apr 10, 2001 01:50 AM

The Birmingham News

2 survive crash after plane hits deer at Troy field

Errant gull sparks plane fire

Carmelina Prete
The Hamilton Spectator

A WestJet Boeing 737 with 62 passengers aboard was forced t return to the Hamilton airport yesterday after a gull was sucked into an engine, starting a fire. Left to right, passengers David

Polish jumbo makes emergency landing in Warsaw

2000

01/15/01
WILLIAM THORNTO
s staff writer

Jerry while h

sport plane

nd it landed with

to Dallas Cowboys' owner er and then burst into flames y Regional Airport Sunday.

Australia 25 May 2001

Fox cause of Ansett 737 grounding

An Ansett 737 is not expected to be b a fox was sucked into its engine.

The plane was flying from Me last night, when the problem was discovered a

Plane crash kills 21 in rebel-held Congo

KIGALI, April 20 (Reuters) - At least 21 people including five Rwandan army officers were killed when crashed in the east of the Democratic Republic of the Congo, army officials said on Thursday. A bird hit one of the engines as it was taking off and the engine failed. They were unable to maintain full fuel and exploded.

DISASTER ON FLIGHT 587

American has another Airbus scare at JFK

Jet forced to land in engine emergency; birds blamed

By Paul Sperry
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An American Airlines flight to the Caribbean was forced to land Friday at John F. Kennedy International Airport after the pilot reported problems with one of the Airbus A300 engines, company officials confirmed today.

An American spokesman in Dallas blamed the emergency landing on a flock of birds likely flying south for the winter.

Jet blov takeoff is aborted

The A , January 22, 2001

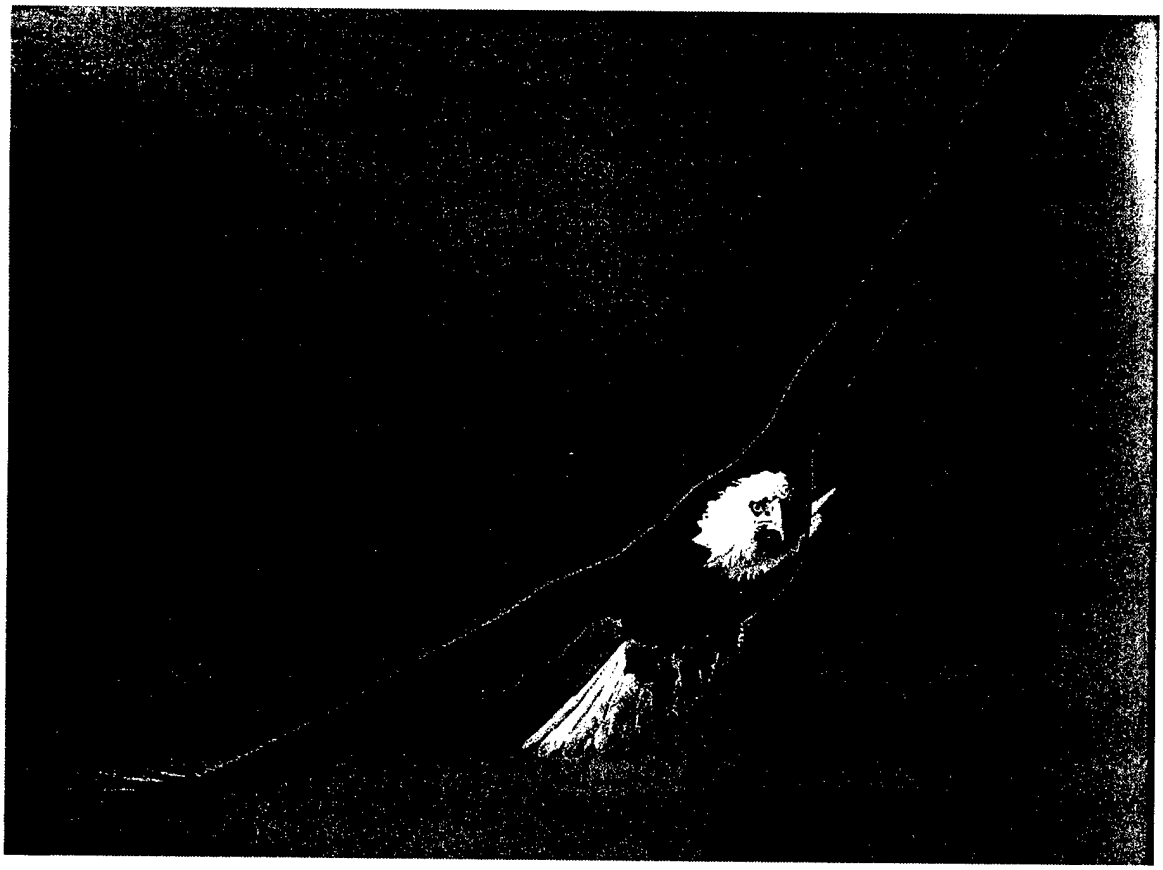
ita Air Lines flight aborted takeoff at nal Airport yesterday afternoon after a bird o its engine.

LOCATIONS OF ANNUAL MEETINGS
BIRD STRIKE COMMITTEE-USA

August 1991	Atlantic City International Airport (FAA Technical Center)	Atlantic City, New Jersey
August 1992	JFK International Airport	New York, New York
August 1993	SEATAC International Airport	Seattle, Washington
August 1994	O'Hare International Airport	Chicago, Illinois
August 1995	Dallas/Ft. Worth International Airport	Dallas, Texas
July 1996	Phoenix Sky Harbor International Airport	Phoenix, Arizona
August 1997	Logan International Airport	Boston, Massachusetts
June 1998	Burke Lakefront Airport	Cleveland, Ohio
May 1999*	Vancouver International Airport	Vancouver, BC
August 2000*	Minneapolis/St. Paul International Airport	Minneapolis, Minnesota
August 2001*	Calgary International Airport	Calgary, Alberta
October 2002*	Sacramento International Airport	Sacramento, California

* Joint meeting with Bird Strike Committee Canada.

THANKS SACRAMENTO!



Safer Skies for All who Fly—Birds and People!

Bird Strike Committee USA thanks the Sacramento County Airport System for hosting the 4th Joint USA/Canada Meeting. The Committee also thanks USDA, Wildlife Services and the USAF, Office of Scientific Research for their support of the conference. We look forward to seeing you and your colleagues in Toronto in 2003 and at future meetings.

Richard A. Dolbeer, Chairperson, BSC-USA 2002